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Mariners Weather Log

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Cover: The French trawler CITE D'ALETH, bow out of water, is about to plunge into an oncoming wave. Rough seas off the Scottish coast hindered rescue operations on January 21 after the vessel reported a fire onboard. (For a description of the storm that lashed the British Isles, see Rough Log, North Atlantic Weather, on page 224.) Wide World Photo.

Back cover: Survivors of the November 1970 tropical cyclone that struck Bangladesh plead for food. The storm surge that swept the area caused about 300,000 deaths. (For information on tropical cyclones of the north Indian Ocean, see page 191.) Wide World Photo.

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WORLD OF TROPICAL CYCLONES: NORTH INDIAN OCEAN

Dick DeAngelis
Environmental Data Service, NOAA
Washington, D. C.

Several days of hot, humid weather had plagued the coast of East Pakistan (Bangladesh) in late May of 1963. Relief was brought by a breeze which sprang up on the evening of the 28th. Within a few hours the breeze became a gale, the gale a hurricane. Before it was over, the coast reeled under a 15-hr pummeling of winds and waves generated by a small but vicious tropical cyclone. At Chittagong winds reached 130 kn. The resort town of Cox's Bazar lay in ruins. The offshore islands were devastated. Some 22,000 people had died, and more than one million were left homeless. Captain H. D. Smith, master of the INDIA MAIL, which was docked at Chittagong during the blow, wrote: "Perhaps the most outstanding and pathetic features of this storm were the insufficient warning for a storm of this magnitude and the phenomenal suddeness with which the storm came to vanish after a short but lethal duration."

These storms are less of a surprise now, with the increased use of satellites for detection and tracking. Satellite photographs also help estimate the intensity of these tropical cyclones. During the satellite era the number of tropical depressions reaching tropical storm strength has increased by 75 percent, while the number of tropical storms reaching severe proportions (winds $\geq$ 48 kn) has increased nearly 50 percent. The Indians use this severe cyclonic storm category rather than the hurricane classification.

Table 1.--Some of the more significant storm tide disasters in the Bay of Bengal

Date	Area affected	Maximum * storm tide (ft)	Maximum winds (kn)	Estimated deaths
1737 (Oct.)	South of Calcutta	40		300,000
1789 (Dec.)	Coringa			30,000
1864 (Oct.)	Calcutta	40		80,000
1876 (Oct.)	Bakarganj	30-40		215,000
1885 (Sept.)	False Point	22		10,000
1926 (May)	Burma			1,200
1941 (June)	Barisal			5,000
1942 (Oct.)	Bengal	16	80-85	40,000
1949 (Oct.)	Southeastern India			1,000
1960 (Oct.)	Bangladesh	12	60	6,000
1960 (Oct.)	Bangladesh	20	113	4,000
1961 (May)	Bangladesh	16	90	2,000
1963 (May)	Bangladesh		130	22,000
1964 (Dec.)	Ceylon	15-20		1,800
1965 (May)	Bangladesh	12	85	15,000
1965 (Dec.)	Bangladesh	12	120	15,000
1970 (Nov.)	Bangladesh	20	130	300,000
1971 (Oct.)	Orissa	20	100	10,000

*In most early storms, these are estimates.

Tropical cyclones of the North Indian Ocean, particularly the Bay of Bengal, have long been recognized as killers because of their devastating storm tides. As far back as 1737, a 40-ft "wall of water" was reported to have killed some 300,000 people (table 1). In November 1970 a severe cyclone (fig. 1) pushed a 20-ft storm surge over Bangladesh and the offshore islands. Loss of life was roughly estimated at 300,000. This storm also generated 130-kn winds, which added to the devastation. These cyclones, while noted for their storm tides, can also produce severe

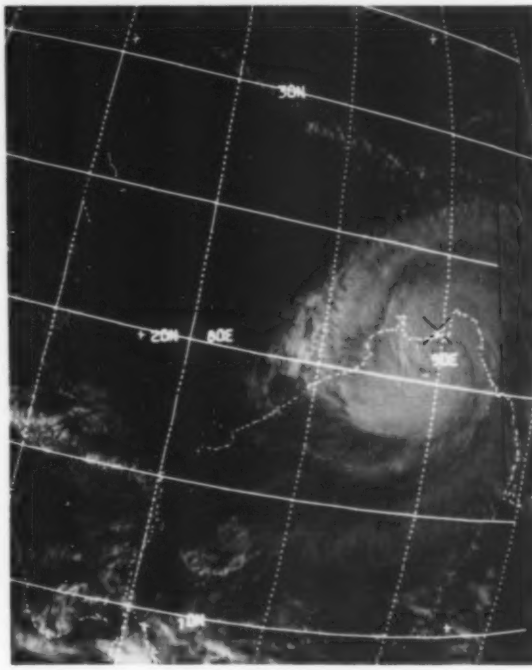

Figure 1.--ITOS 1 catches historic Bay of Bengal tropical cyclone as it approaches the low-lying Bangladesh coast on November 12, 1970.

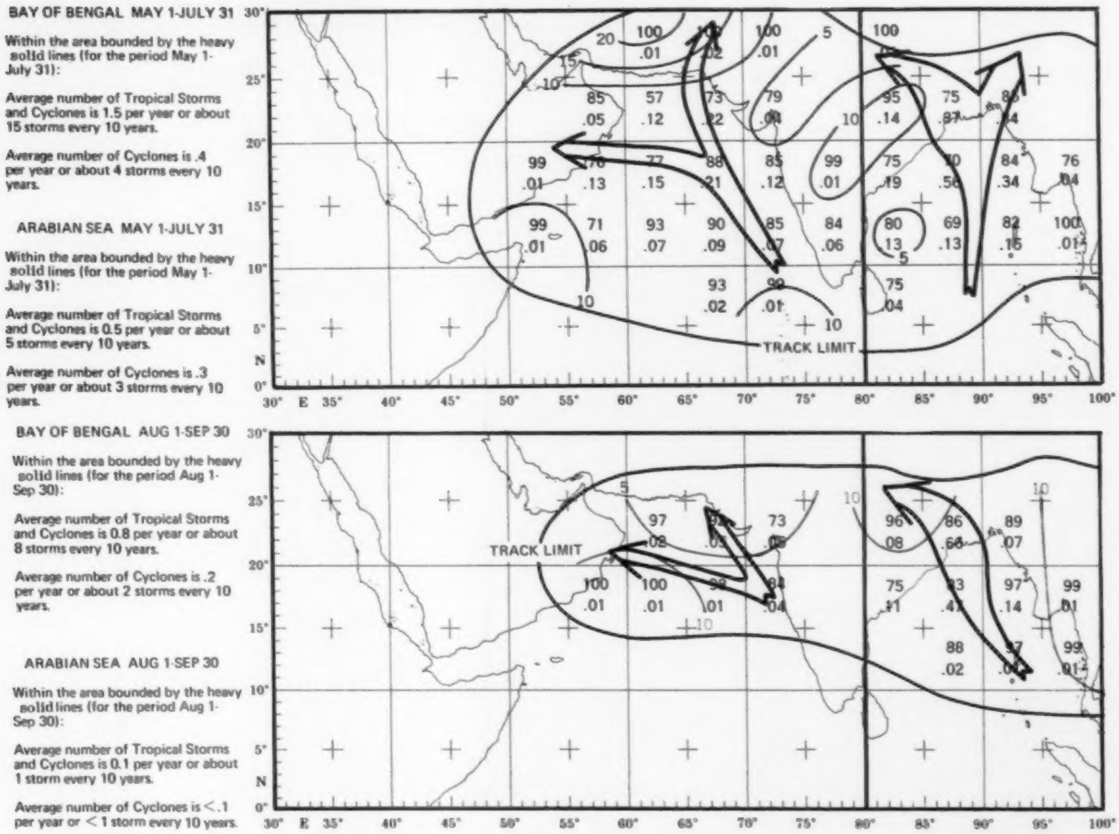

Figure 2.--Arrows show preferred storm track. Arrow width is proportional to the storm frequency within the ocean basin and the time period for each chart. Isolines show the average storm speed (scalar) in kn. The top value for each 5° square is the constancy. The bottom value is the average number of tropical storms and hurricanes per time period per 5° square.

winds and high waves.

In addition to the 130-kn winds in the 1963 and 1970 storms, the Rameswaram cyclone of December 1964 generated winds estimated at 150 to 175 kn and waves of 30 ft or more. In 1965 a December tropical cyclone bearing 120-kn winds and another in May packing 85-kn winds both struck the Bangladesh coast.

Arabian Sea tropical cyclones, although usually not as intense, do occasionally reach hurricane strength. In May 1963, shortly before the devastating Bay of Bengal storm, an Arabian Sea cyclone generated 104-kn winds around a 947-mb center. It also dumped 9 in of rain on Salalah on the Arabian coast, where the average annual rainfall is 4.4 in. In November 1966 an 80-kn cyclone brought 7 in of rain to Salalah.

Arabian Sea cyclones are most noted for their rainfall, particularly along its arid western and northern shores. On these coasts infrequent storms contribute significantly to the scanty rainfall amounts. At Salalah, for example, tropical cyclones are responsible for about 25 percent of the total rainfall, even though they affect the area only once every 5 yr on the average.

Over the entire Arabian Sea the annual average is 1.4 tropical cyclones or 14 every 10 years; about one-half of these become severe cyclonic storms. However, some storms may move into this basin from the Bay of Bengal, which spawns an annual average of 4.8 tropical cyclones (winds $\geq$ 34 kn); three of these reach severe proportions on the average. These statistics are given in more detail in tables 2 through 4, which

Table 2.--Tropical cyclone frequencies, North Indian Ocean

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1961					3 (1)	1 (0)			1 (0)				5 (3)
1962					1 (0)				1 (0)	1 (1)	1 (1)	1 (1)	5 (3)
1963					2 (0)					2 (1)	1 (0)	1 (0)	6 (3)
1964					4 (0)	1 (1)		1 (0)			3 (2)	1 (1)	10 (4)
1965					2 (1)						1 (0)	3 (2)	6 (4)
1966				1 (1)					2 (1)		2 (1)	2 (1)	7 (4)
1967					1 (1)					3 (2)		1 (1)	5 (4)
1968					1 (1)				2 (1)	1 (1)	2 (1)	1 (0)	7 (4)
1969					1 (0)			1 (0)		2 (0)	1 (1)	1 (0)	6 (1)
1970					2 (1)	1 (0)				1 (1)	2 (1)		6 (3)
1971					1 (0)	1 (1)			1 (1)	2 (0)	1 (1)	1 (1)	7 (4)
1972				1 (1)			1 (0)		2 (2)	1 (1)	1 (1)	1 (1)	7 (6)
1973					1 (0)		1 (0)			1 (0)	2 (2)	1 (1)	6 (3)
1974				1 (1)	1 (1)	1 (0)		1 (0)	2 (2)		1 (1)		7 (5)
1975	1 (0)				2 (2)					1 (1)	2 (0)		6 (3)

( ) severe cyclonic storm, winds $\geq$ 48 kn

BAY OF BENGAL OCT 1-NOV 30

Within the area bounded by the heavy solid lines (for the period Oct 1-Nov 30):

Average number of Tropical Storms and Cyclones is 1.6 per year or about 16 storms every 10 years.

Average number of Cyclones is .6 per year or about 6 storms every 10 years.

ARABIAN SEA OCT 1-NOV 30

Within the area bounded by the heavy solid lines (for the period Oct 1-Nov 30):

Average number of Tropical Storms and Cyclones is 0.6 per year or about 6 storms every 10 years.

Average number of Cyclones is .3 per year or about 3 storms every 10 years.

BAY OF BENGAL DEC 1-31

Within the area bounded by the heavy solid lines (for the period Dec 1-31):

Average number of Tropical Storms and Cyclones is 0.5 per year or about 5 storms every 10 years.

Average number of Cyclones is .2 per year or about 2 storms every 10 years.

ARABIAN SEA DEC 1-31

Within the area bounded by the heavy solid lines (for the period Dec 1-31):

Average number of Tropical Storms and Cyclones is 0.1 per year or about 1 storm every 10 years.

Average number of Cyclones is < .1 per year or < 1 storm every 10 years.

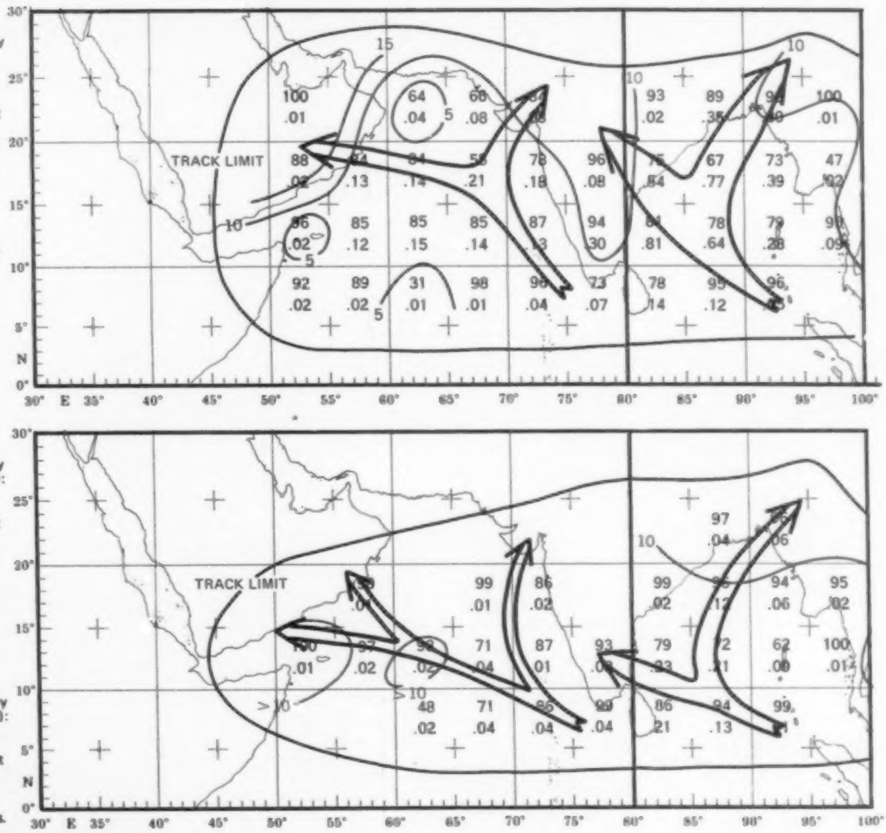

Figure 3.--Arrows show preferred storm track. Arrow width is proportional to the storm frequency within the ocean basin and the time period for each chart. Isolines show the average storm speed (scalar) in kn. The top value for each 5° square is the constancy. The bottom value is the average number of tropical storms and hurricanes per time period per 5° square.

indicate that spring and fall are the most active seasons.

Fall, from mid-September through mid-December, is the most active season. The surface, low-level, and upper-level circulation features are all conducive to tropical cyclone development as they migrate southward. A low-level trough is usually oriented east-west across the North Indian Ocean with the Intertropical Convergence Zone at the surface and a high-pressure ridge in the upper atmosphere. Also, tropical cyclones from the South China Sea occasionally survive an overland trek across Burma or the Malay Peninsula to redevelop in the Bay of Bengal or Andaman Sea. Tropical cyclones originating in the Bay tend to form south of 15°N by October. Spring, from mid-April through mid-June, is the second most active season. The circulation changes are more rapid than fall, and the low-level trough is often weak or absent. The upper-level pattern is similar. Migration of these features is northward at a more rapid pace.

The summer and winter monsoon seasons are usually unfavorable for tropical cyclone development. In the summer the low-level trough and the ITCZ have moved over land to the north, while in winter they lie south of the Equator. It is only when they fluctuate from their normal positions to move over the Bay of Bengal or Arabian Sea that a tropical cyclone, most likely a tropical depression, may develop. These weak storms are usually short lived. Average tropical cyclone movements and probabilities are shown in figures 2 and 3. The figures were obtained from the U.S. Navy's Mariner's Worldwide Climatic Guide to Tropical Storms at Sea by Crutcher and Quayle.

For each 5° square there are two numbers on the charts. Constancy is the top value and is a measure of confidence in direction persistence; i.e., when the constancy is high (90 to 100), there is a high likelihood that a storm will continue in the same general direction for 12 hr. As the constancy decreases, confidence that a storm will remain on course decreases. Constancy, as a confidence measure, is directly related to the number of storms used to determine the figure. The bottom number is the average number of storms per year for the time period of that chart.

Table 3.--Tropical cyclone frequencies, Bay of Bengal

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1961					2 (1)				1 (0)				3 (1)
1962					1 (0)				1 (0)	1 (1)	1 (1)	1 (1)	5 (3)
1963					1 (1)					1 (1)		1 (0)	3 (2)
1964					1 (0)						2 (2)	1 (1)	4 (3)
1965					2 (2)						1 (0)	2 (2)	5 (4)
1966				1 (1)					1 (1)		2 (1)	2 (1)	6 (4)
1967					1 (1)					3 (2)		1 (1)	5 (4)
1968					1 (1)				2 (1)	1 (1)	2 (1)	1 (0)	7 (4)
1969					1 (0)			1 (0)		2 (0)	1 (1)	1 (0)	6 (1)
1970					1 (1)	1 (0)				1 (1)	1 (1)		4 (3)
1971					1 (0)	1 (1)			1 (1)	1 (1)	1 (1)		5 (4)
1972				1 (1)			1 (0)		2 (1)		1 (1)	1 (1)	6 (4)
1973							1 (0)			1 (0)	2 (2)	1 (1)	5 (3)
1974						1 (0)		1 (0)	1 (1)		1 (1)		4 (2)
1975	1 (0)				1 (1)						2 (0)		4 (1)

( ) severe cyclonic storm, winds ≥ 48 kn

Table 4.--Tropical cyclone frequencies, Arabian Sea

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1961					1 (1)	1 (0)							2 (1)
1962													0 (0)
1963					1 (1)					1 (0)	1 (0)		3 (1)
1964						1 (1)		1 (0)			1 (0)		3 (1)
1965												1 (0)	1 (0)
1966									1 (0)				1 (0)
1967													0 (0)
1968													0 (0)
1969													0 (0)
1970					1 (0)						1 (0)		2 (0)
1971										1 (1)		1 (1)	2 (2)
1972										1 (1)			1 (1)
1973						1 (0)							1 (0)
1974				1 (1)	1 (1)				1 (1)				3 (3)
1975					1 (1)					1 (1)			2 (2)

( ) severe cyclonic storm, winds ≥ 48 kn

Multiplication of this number by 10 or by 100 gives the approximate average number of storms per 10 yr or 100 yr, respectively.

More than 85 percent of all tropical cyclone deaths result from storm tides, and most of the death and devastation occurs at the head of the Bay of Bengal. The storm tide is a result of the normal astronomical tide plus the storm surge, which depends on such factors as winds, pressure, waves, and rainfall. The importance of these factors increases as the storm approaches the coast. The configuration of the coast and the bottom topography make the northern, low-lying shores of the Bay of Bengal extremely susceptible to storm tides. Most of the severe tides have occurred in the fall, particularly during October and November. They can occur before or after the storm crosses the coast and either ahead of it or to the right of the track. Storm tide heights range, in general, from 10 to 15 ft above mean sea level (msl) and can extend several miles inland if the land is flat.

The November 1876 Backergunge cyclone moved inland, over the Mouths of the Ganges, between Calcutta and Chittagong. The lowlands were covered to depths from 10 to 40 ft. Up to 16 ft of water covered a 250 sq mi area in the southern part of Midnapore as the result of a storm tide in October of 1942.

The east coast of India is sometimes vulnerable. In November of 1952 a storm tide near Negappattinam brought 5 to 6 ft of water 2 to 7 mi inland. The Rameswaram cyclone of December 1964 is one of the severest storms on record. This small but intense hurricane was at its peak when it struck the east coast of Ceylon, just north of Trincomalee, where windspeeds were estimated at 120 to 150 kn. At Vovuniya speeds of 150 to 175 kn were estimated. Along with these winds and 10-in rains came storm tides of 15 to 20 ft above msl. Tides were also high over Mannar and Rameswaram Islands. Destruction was devastating and more than one thousand people lost their lives.

Like the Rameswaram cyclone, the May 1963 storm combined everything that is to be feared in North Indian tropical cyclones--severe winds, devastating storm tides, torrential rains, and high seas. The one other ingredient that makes the storms even more dangerous by adding the element of surprise is their infrequency.

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WESTERN NORTH PACIFIC TYPHOONS, 1975

Based on information furnished by the U.S. Fleet Weather Central, Joint Typhoon Warning Center, Guam, Mariana Islands.

There was a sharp decrease in tropical cyclone activity from last season. There were only 20 named tropical cyclones in 1975, a 30-percent decrease from the long-term average of 28.6. Since 1945, only 1973 exceeds 1975 for total number of consecutive days without a named tropical cyclone. The record in 1973 was 183 consecutive days, while in 1975, 180 days elapsed between typhoon Lola in January and tropical storm Mamie in July. Of the 20 named tropical storms occurring between July 27 and November 24, 13 became typhoons. Three of these, Nina, Elsie, and June, became supertyphoons with maximum winds exceeding 130 kn. The most noteworthy event of the 1975 season was the occurrence of supertyphoon June, the most intense tropical cyclone ever recorded.

At 0843 on November 19, reconnaissance aircraft measured a record low 700-mb height of 1,984 m while traversing the eye and obtained a coincident minimum sea-level pressure (MSLP) of 876 mb (25.87 in) by dropsonde near the cloud wall. This observation was the lowest on record, slightly lower (1 mb) than typhoons Ida in 1958 and Nora in 1973. June's central pressure well surpasses the lowest Western Hemisphere reading (892.3 mb), and that obtained by aircraft in hurricane Camille (905 mb).

Casualty reports indicate that typhoons Phyllis and Rita accounted for the majority of tropical cyclone related casualties in Japan. Phyllis caused 60 deaths and 146 injuries in mid-August. Later in the month, Rita reportedly caused the worst flooding on Hokkaido in 10 yr. On Taiwan, typhoon Nina caused 25 deaths and 168 injuries, also sinking a small freighter. Typhoon Betty, in September, caused an additional 12 deaths and injured scores. The Republic of the Philippines suffered casualties from typhoon Lola in January and two tropical depressions in December. Most deaths were caused by extensive flooding of low-lying areas. Lola accounted for the loss of 30 lives and serious damage to sugar-producing areas on the southern islands. The tropical depressions, although limited in destructive winds, caused torrential rains, and 97 lives were lost in the resulting floods. The greatest at-sea disaster occurred in the South China Sea when typhoon Flossie sank two timber freighters with the loss of 44 lives in late October.

Tables 5 and 6 show the distribution of typhoons and tropical cyclones by month and year from 1959 on with an average from 1945 through 1958. The comparison of averages between the two periods represents the influence of satellite data and increased ship reports.

The statistics for 1975 storms are contained in table 7. The cyclone tracks shown in figures 4 to 6 are based on poststorm analysis. The dates given include the period when the storm was first identifiable, no matter what stage, until it dissipated or became extratropical. The maximum winds are overwater estimates of sustained windspeeds for a 1-min averaging period.

Table 5.--Frequency of tropical storms and typhoons by month and year

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Average (1945-58)	0.4	0.1	0.4	0.5	0.8	1.3	3.0	3.9	4.1	3.3	2.7	1.1	22.0
1959	0	1	1	1	0	0	2	6	6	4	2	2	26
1960	0	0	0	1	1	3	3	10	3	4	1	1	27
1961	1	1	1	1	3	3	5	4	5	5	1	1	31
1962	0	1	0	1	2	0	6	7	3	5	3	2	30
1963	0	0	0	1	1	3	4	3	5	5	0	3	25
1964	0	0	0	0	3	2	7	9	7	6	6	1	40
1965	2	2	1	1	2	3	5	6	7	2	2	1	34
1966	0	0	0	1	2	1	5	8	7	3	2	1	30
1967	1	0	2	1	1	1	6	8	7	4	3	1	35
1968	0	0	0	1	1	1	3	8	3	6	4	0	27
1969	1	0	1	1	0	0	3	4	3	3	2	1	19
1970	0	1	0	0	0	2	2	6	4	5	4	0	24
1971	1	0	1	3	4	2	8	4	6	4	2	0	35
1972	1	0	0	0	1	3	6	5	4	5	2	3	30
1973	0	0	0	0	0	0	7	5	2	4	3	0	21
1974	1	0	1	1	1	4	4	5	5	4	4	2	32
1975	1	0	0	0	0	0	2	4	5	5	3	0	20
Average (1959-75)	0.3	0.4	0.5	0.8	1.2	1.6	4.0	6.1	4.9	4.1	2.6	1.1	27.6

Table 6.--Frequency of typhoons by month and year

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Average (1945-58)	0.4	0.1	0.3	0.4	0.7	1.1	2.0	2.9	3.2	2.4	2.0	0.9	16.3
1959	0	0	0	1	0	0	1	5	3	3	2	1	16
1960	0	0	0	1	0	2	2	8	0	4	1	1	19
1961	0	0	1	0	2	1	3	3	5	3	1	1	20
1962	0	0	0	1	2	0	5	7	3	4	2	0	24
1963	0	0	0	1	1	2	3	2	3	4	0	2	19
1964	0	0	0	0	2	2	6	3	5	3	4	1	26
1965	1	0	0	1	2	2	4	3	5	2	1	0	21
1966	0	0	0	1	2	1	3	6	4	2	0	1	20
1967	0	0	1	1	0	1	3	4	4	3	3	0	20
1968	0	0	0	1	1	1	1	4	3	5	4	0	20
1969	1	0	0	1	0	0	2	3	2	3	1	0	13
1970	0	1	0	0	0	1	0	4	2	3	1	0	12
1971	0	0	0	3	1	2	6	3	5	3	1	0	24
1972	1	0	0	0	1	1	4	4	3	4	2	2	22
1973	0	0	0	0	0	0	4	2	2	4	0	0	12
1974	0	0	0	0	1	2	1	2	3	4	2	0	15
1975	1	0	0	0	0	0	1	3	4	3	2	0	14
Average (1959-75)	0.2	0.1	0.1	0.7	0.9	1.1	2.9	3.8	3.2	3.2	1.6	0.6	18.7

Table 7.--Western North Pacific tropical cyclones, 1975

Name	Intensity	Period of Warning	Maximum surface wind (kn)	Minimum observed sea level pressure(mb)
Lola	TY	January 22-28	70	976
Mamie	TS	July 27-29	40	994
Nina	TY	July 31-August 4	135	904
Ora	TY	August 10-12	65	976
Phyllis	TY	August 12-18	120	920
Rita	TY	August 18-23	80	966
Susan	TS	*	50	---
Tess	TY	September 2-10	95	945
Viola	TS	September 5-7	45	996
Winnie	TY	September 9-12	65	---
Alice	TY	September 16-20	75	971
Betty	TY	September 17-23	95	944
Cora	TY	October 1-6	105	943
Doris	TS	October 3-6	55	---
Elsie	TY	October 9-15	135	900
Flossie	TY	October 20-23	70	977
Grace	TS	October 25-Nov. 2	60	994
Helen	TS	November 3-4	45	998
Ida	TY	November 6-11	85	959
June	TY	November 16-24	100	876

*Susan, August 26-27 and August 29-Sept. 1
TS - Tropical Storm; TY - Typhoon

The individual typhoons during 1975 are described in the following narratives. Specific times and figures are GMT. Tropical storm summaries can be found in the appropriate "Smooth Log" of the Mariners Weather Log.

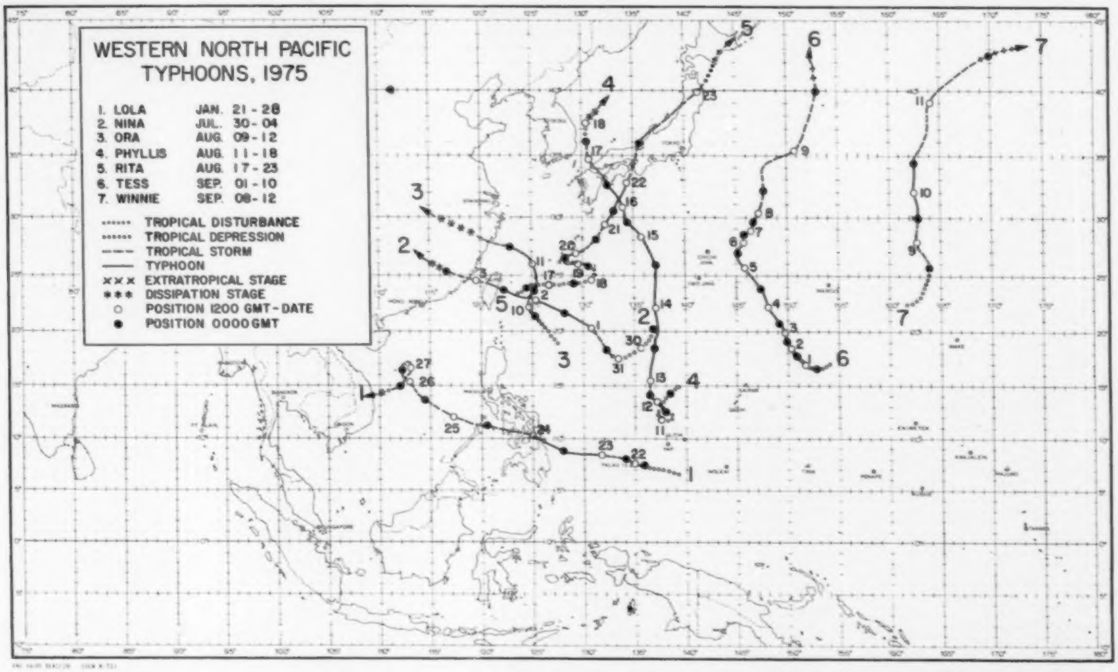


Figure 4. --Tracks of western North Pacific typhoons, January - September 12, 1975.

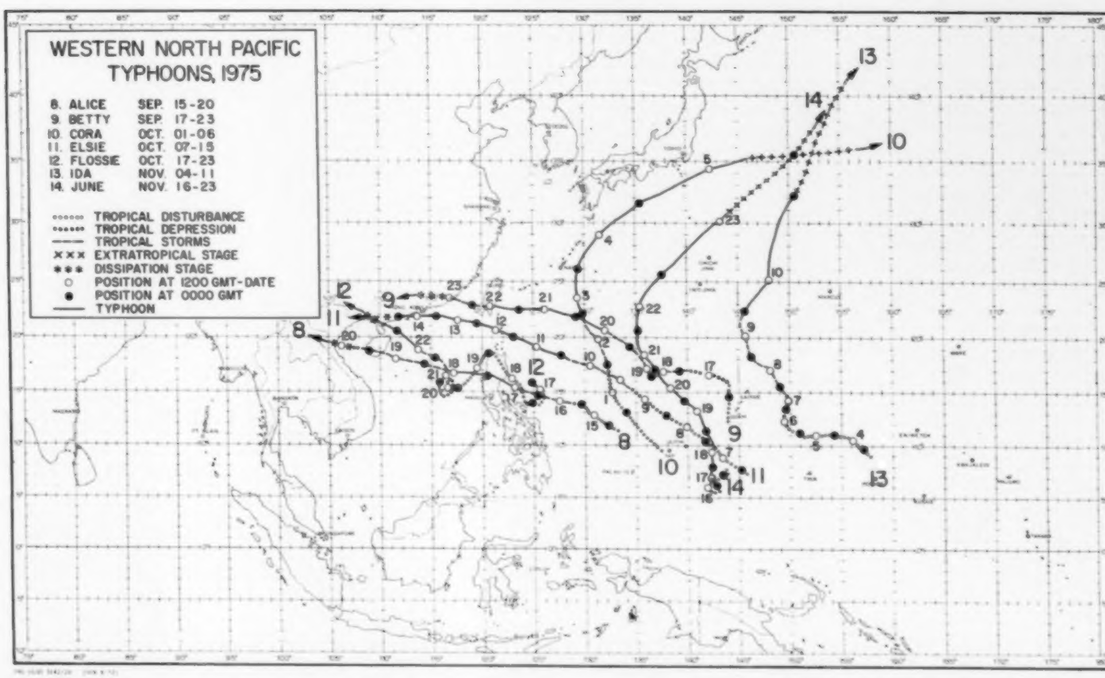


Figure 5. --Tracks of western North Pacific typhoons, September 15 - December, 1975.

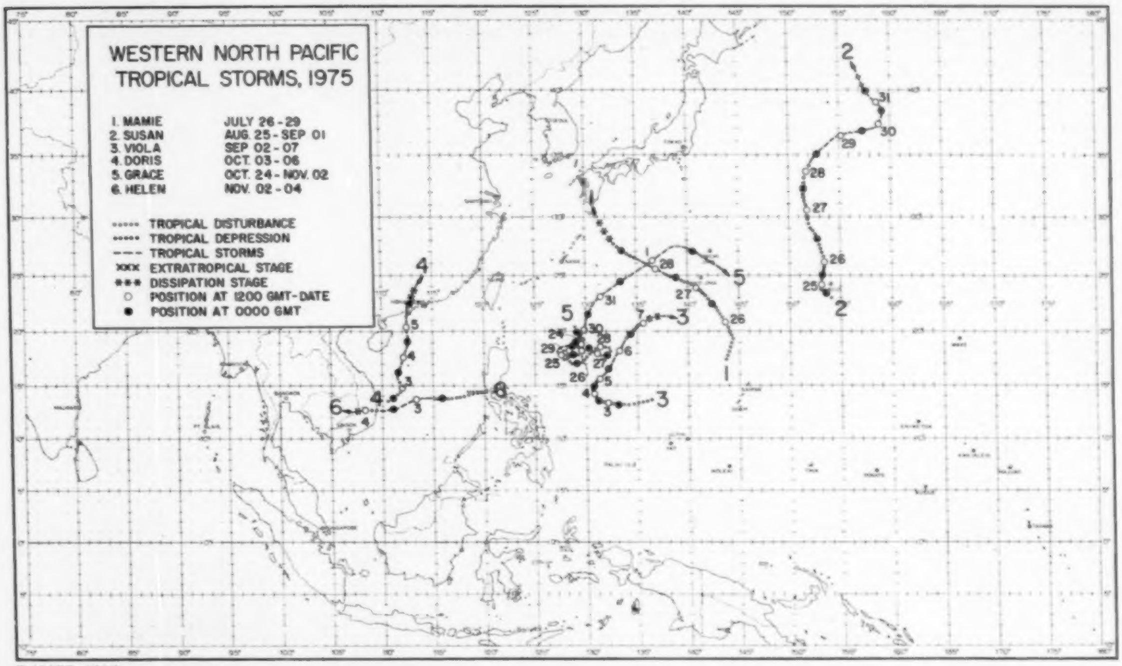


Figure 6.--Tracks of western North Pacific tropical storms, 1975.

LOLA

In mid-January, the monsoon trough, normally located south of 5°N during this time of year, moved northward. A circulation was first detected in the trough on January 18 approximately 400 mi south of Guam. Over the next 5 days this tropical disturbance was to develop into typhoon Lola. Lola was distinguished by being only the ninth typhoon in the month of January since 1945.

From its origin, the circulation tracked west-northwestward as it intensified to tropical storm strength on January 22. At that time Lola was 75 mi east of the Palau Islands with northwesterly winds of 35 kn observed on Koror. Wind, rain, and high seas from Lola lashed the Palau Islands for the next 24 hr as the storm moved through. Major damage to agriculture occurred on the northernmost island of Kayangel, with banana, papaya, coconut, and taro crops nearly totally destroyed.

From the Palau Islands, Lola moved westward under the steering influence of strong 500-mb ridging to the north. With upper-level outflow restricted in the eastern semicircle by strong ridging to the east, Lola developed to minimal typhoon strength late on the 23d. Aircraft reconnaissance reports on the 24th indicated the typhoon's central pressure had reached its minimum of 976 mb.

Typhoon Lola struck the central Philippines' sugar-producing provinces near peak intensity on the afternoon of the 24th. At least 30 persons were reported killed by landslides and flying debris, with more than 300 houses in the coastal town of Tandog destroyed by the storm surge.

Lola decreased to tropical storm strength while crossing the Philippines and entered the South China Sea. The storm then pursued a west-northwest track as the 500-mb ridge receded eastward. Lola regenerated to a peak intensity of 50 kn on the morning of the 26th. By the following morning, a cold frontal surge from Asia pushed into the South China Sea, weakening the circulation significantly. The remains of Lola moved southward in response to the building high pressure to the north. On the 28th satellite data indicated that the upper-level anticyclone had sheared off, and the remains of the surface circulation had drifted southward.

NINA

As tropical storm Mamie dissipated and drifted toward Korea, the monsoon trough migrated northward leaving a well-defined trough line extending southeastward from the remains of Mamie into the Philippine Sea. A tropical disturbance spawned in this trough on July 29 and rapidly developed into typhoon Nina, one of the most destructive storms of the season. After initial detection by satellite, the tropical disturbance moved southwestward for approximately 36 hr as surface and upper-air circulations became organized and vertically alined. By 1200 on the 31st the system slowed, intensified rapidly to tropical storm strength, and began turning to the northwest.

Nina underwent explosive deepening late on August 1. Aircraft reconnaissance data indicated a 63-mb drop in sea-level pressure at the typhoon's center between the 1st at 1437 and the 2d at 0830, with maximum surface winds increasing from 65 kn to 130 kn during that period. A peak intensity of 135 kn was attained on the 2d at 1200, approximately 200 mi east

of Taiwan. The typhoon slowly decreased in intensity while approaching the island, making landfall near the coastal city of Hualien on the 3d at 0300 with maximum surface winds of 100 kn.

Much of the typhoon's strength was lost as it battered across Taiwan's central mountain range, fortunately sparing the most populous areas from the more intense winds near the eye. Nevertheless, Nina's trek across Taiwan reportedly left 25 people dead, 4 missing, and 168 injured. It was also reported that over 3,000 homes were at least partially collapsed, 39 fishing boats were sunk, and a 16,000-ton Korean freighter, the SUN STAR, was capsized near Koahsiung harbor. Damage from flooding and landslides was widespread. Nina entered the Formosa Straits with minimal typhoon strength, and weakened to approximately 60 kn before striking the China mainland on the 3d at 1500. Nina moved inland and lost tropical cyclone characteristics on the 4th.

ORA

The third typhoon of the season, Ora, was small and short lived. Ora first appeared as a weak circulation on the evening of the 8th. During the next 30 hr, this weak circulation moved northwestward at 6 kn showing little intensification. On the morning of the 10th, a rapidly moving upper-level trough in the midlatitude westerlies was located to the northwest of the circulation. This trough provided a highly efficient high altitude outflow channel which allowed Ora to grow from a tropical depression into a typhoon within 30 hr. As this trough moved quickly toward the east, Ora responded with a north-northeastward movement. When Ora's eye passed over Miyako Jima at 0600 on the 11th, the weather station recorded 5-kn surface winds and a minimum pressure of 976 mb. Simultaneously, a ship (JL 11) 120 mi to the east reported 55-kn sustained winds. At 0749 on the 11th, 50-kn gusts were recorded at Kadena, Okinawa, 150 mi northeast of Ora. As the trough passed to the east, the subtropical high over central China built rapidly eastward and Ora shifted northwestward and accelerated to 15 kn. By the morning of the 12th, Ora had turned westward at 13 kn until landfall was made on the 12th near Yung-chia on the central China coast.

Although little destruction was directly attributed to Ora, monsoon rains were spawned over the Philippines and caused widespread flooding and landslides. Choppy waters near Tocloban, Leyte, capsized a crowded motorboat leaving 15 dead and 30 missing.

PHYLLIS

From early August, the monsoonal trough had extended from the remains of typhoon Nina in central China to an area west of Guam. A number of surface circulations appeared in this trough, but it was not until the morning of the 11th that Phyllis first appeared as a tropical disturbance some 380 mi west-southwest of Guam. By 0600 on the 12th, the disturbance had become a 35-kn tropical storm. Aircraft reported multiple surface centers and a weak and diffuse 700-mb center. On the 13th at 0833, aircraft reported a closed wall cloud with an eye 30 mi in diameter. The Russian research vessel PRIVIV reported surface winds of 60 kn, 60 mi west-southwest of Phyllis at 1200. Phyllis was upgraded to a typhoon with maximum winds of 70 kn.

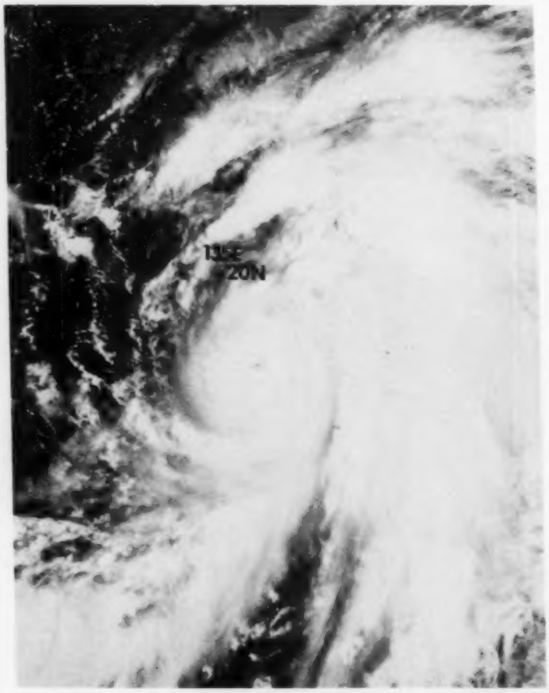


Figure 7.--Packing 90-kn winds typhoon Phyllis is adrift in the Philippine Sea at 2320 on the 13th. Defense Meteorological Satellite Program (DMSP) Imagery.

By the 13th the midtropospheric ridge over China began to weaken while the ridge east of Japan intensified (fig. 7). Twenty-four hours later, Phyllis' forward speed had increased to 18 kn. The typhoon attained a maximum intensity of 120 kn on the 14th after aircraft had recorded a minimum sea-level pressure of 920 mb. By the 15th, Phyllis' movement had slowed to 7 kn and had become northwestward as the midtropospheric ridge built westward across Japan. After turning to the northwest, Phyllis once again accelerated and by the afternoon of the 16th, was located 165 mi southeast of Shikoku. As Phyllis approached Japan, Shimizu (elevation 99 ft) recorded sustained surface winds of 77 kn on the 16th at 1800 and a minimum pressure of 970 mb at 2300. Murotomisaki (elevation 606 ft) recorded sustained surface winds of 73 kn at 2000 on the 16th. Phyllis, with 80-kn sustained winds, made landfall during the morning of the 17th near the southwestern edge of Shikoku.

In her wake Phyllis left extensive damage and loss of life (fig. 8). On Shikoku alone there were at least 60 dead, 146 injured, and 12 missing due to the combination of heavy rains, flooding, and numerous landslides. At least 489 houses were reported collapsed, 577 damaged, 58 washed away, and thousands inundated.

RITA

The third typhoon in August, Rita, made landfall over Japan in the wake of typhoon Phyllis. The heavy

Figure 8. --Walking the streets of Kochi after Phyllis' visit to Shikoku on the 17th. United Press International Photo.

Figure 9. --High waves from typhoon Rita pound the beach and what appears to be a breakwater, at Ote Beach, Tokushima Prefecture, Shikoku, on the 22d. Photo courtesy of The Japan Times.

rains brought by Rita made the storm the most damaging to affect northern Japan since 1965.

The typhoon's birth can be traced to the development of a monsoon depression some 180 mi southeast of Okinawa on the 18th. Drifting first east then westward, Rita began to gain strength as aircraft reconnaissance reports verified storm-force winds in the circulation on the following day. A minimum pressure of 983.4 mb was registered at Kadena Air Base on the 20th, although winds were comparatively light with a peak gust of 37 kn from the northwest recorded at 0514. An approaching short wave over Manchuria began to draw Rita on a more northward course late on the 20th. By the afternoon of the 21st, typhoon-force winds were reached and Rita's circulation had grown significantly in size. Gale-force winds extended some 300 mi in the typhoon's eastern semicircle. As the short wave continued to approach the typhoon, Rita accelerated gradually in a north-northeasterly direction, making landfall 30 mi west of Osaka late on the 22d (fig. 9). Prior to landfall, Rita's 40 - 60 mi diameter eye passed over Murotomisaki (elevation 606 ft), Shikoku. The station experienced a pressure reading of 966.3 mb and sustained surface winds of 80 kn.

Quickly crossing central Honshu, Rita veered slightly and accelerated to speeds of 30-35 kn ahead of an advancing cold front in the Sea of Japan. First tracking along the western coast, Rita crossed the northern portion of Honshu, finally emerging back into the Pacific on a northeasterly heading. Strong gusty winds occurred along the exposed southern coast of Honshu between the Kii and Boso peninsulas. Southerly winds gusting near 55 kn were recorded at Yokota Air Base between 0300 and 0400 on the 23d.

Merging with the frontal zone south of Hokkaido, Rita continued to track northeastward as an extratropical low. Torrential rains swept Hokkaido with amounts totaling near 8.2 in in 24 hr. Landslides and flash flooding as a result of the rains were responsible for extensive crop and property damage with farmlands inundated and 36,000 houses flooded throughout Japan. At least 26 deaths were attributed to the typhoon. Newspaper reports indicate that it was the worst flooding in 10 yr for Hokkaido. Several major rivers on the island overflowed their banks leaving towns marooned and isolated.

TESS

While her beginnings can be traced back to August, the first warning on Tess was issued on the morning of September 2 after reconnaissance aircraft and satellite data indicated rapid development. Tess was upgraded to a typhoon on the 3d at 1200 when reconnaissance aircraft reported surface winds of 75 kn approximately 250 mi west of the Maug Islands. The typhoon was now moving in a more northerly direction toward a weakness in the collapsing midtropospheric ridge to the north. Thirty hours later on the 4th at 1800, Tess reached a minimum central pressure of 945 mb and maximum sustained surface winds of 95 kn. On the 7th at 0000, the OREGON reported estimated surface winds of 65 kn while 60 mi east-southeast of the storm's center. Tess maintained typhoon intensity until the 8th at 1800 when it moved into a hostile environment of colder water and began interacting with an approaching frontal system (fig. 10). Satellite data indicated that the typhoon was becoming extratropical, and by the morning of the 10th Tess had merged into the frontal system.

WINNIE

Winnie was first detected by satellite on September 5 as a weak tropical disturbance approximately 300 mi northwest of Wake Island. At this time typhoon Tess

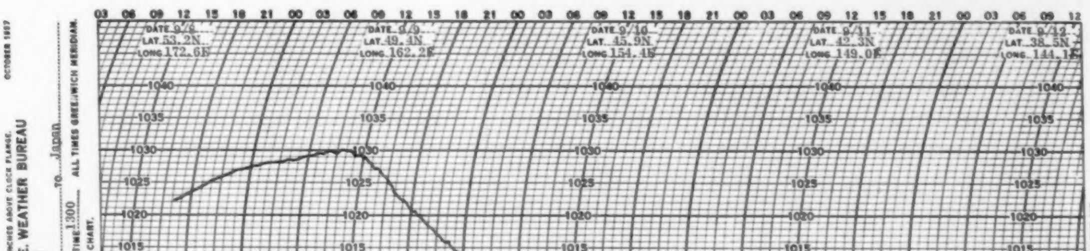


Figure 10.--The ARCTIC TOKYO ran through the extratropical stage of Tess, who was still potent.

was approximately 900 mi to the northwest of Winnie with a surface trough extending southeastward to Wake Island. The combination of surface troughing and a favorable upper-air pattern allowed this disturbance to develop.

From her initial detection as a disturbance, Winnie moved slowly north-northeastward, attaining minimal tropical storm intensity at 2100 on the 8th. The storm was now 400 mi north-northwest of Wake Island and posed no significant threat to any inhabited islands. However, as reported by the Pacific Stars and Stripes, Winnie did represent a threat to shipping and, in fact, sank a 44-ft sailboat, THE FLATBUSH MAN, on a pleasure cruise from Marcus Island to Hawaii. The four people aboard were adrift for 13 days in a rubber raft until September 21 when a Russian whaling vessel picked them up.

From the time of initial tropical storm strength until 1200 on the 11th, Winnie was steered on a northerly course by the combination of a sharp midtropospheric trough to the west and a blocking ridge to the east. A 200-mb trough extending to the west of Winnie inhibited development past minimal typhoon strength with typhoon-force winds persisting only for a 24-hr period from 1800 on the 9th to 1800 on the 10th (fig. 11). The KYOYO MARU, located approximately 35 mi north of Winnie, reported sustained winds of 65 kn at 1800 on the 9th. Approaching a frontal system near 35°N, Winnie came under stronger steering flow, accelerated to near 20 kn, and began to weaken. A short wave trough moving through the long wave ridge diminished its amplitude, and Winnie assumed a more northeasterly track while continuing to accelerate. By 0000 on the 12th, Winnie was absorbed into the frontal system and became an extratropical system with maximum winds of 30 kn.

Figure 11.--Winnie cruises some 650 mi north of Wake Island at 2151 on the 9th. DMSP Imagery.

ALICE

On the morning of the 12th, a tropical disturbance was identified on satellite data near 12°N, 148°E. This system became tropical storm Alice on the afternoon of the 16th and intensified to typhoon strength within 24 hr. On the 17th at 1430, aircraft reconnaissance data indicated a 32-mb drop in central pressure during the previous 21 hr, and maximum flight-level winds of 105 kn were recorded on this eye penetration. Reduced inflow resulting from the development of typhoon Betty (1200 mi to the east) inhibited further development as Alice approached central Luzon. At 2000 on the 17th the typhoon made landfall near Casiguran, Luzon, with maximum surface winds of 75 kn. Alice entered the South China Sea at 0400 on the 18th with surface winds of 65 kn. Wallace Air Station reported winds of 40 kn with gusts to 60 kn at 0129. A peak gust of 42 kn was recorded at Baguio at 0432. No significant damage was reported during the Luzon crossing.

Alice continued on a west-northwest track across the South China Sea in response to moderate steering flow along the southern periphery of the 500-mb subtropical ridge. Maximum surface winds decreased to 60 kn at 1200 on the 18th, and Alice maintained that intensity until just prior to striking the Hainan coast at 1800 on the 19th. Alice was still well organized as she entered the Gulf of Tonkin with 50-kn winds, but she weakened rapidly thereafter and dissipated upon moving inland over North Vietnam.

BETTY

As typhoon Alice approached the Philippine Islands on September 16, another tropical circulation was detected in the monsoonal trough some 200 mi south of Guam. This disturbance passed within 50 mi of Guam early on the 17th. It became a tropical storm on the morning of the 18th while moving westward at 12 kn.

On the 19th, as a weak upper tropospheric trough to the west deepened and created a highly efficient outflow channel in the midlatitude westerlies, Betty began to intensify. At 0230 on the 22d, typhoon Betty attained a maximum intensity of 95 kn as reconnaissance aircraft recorded a minimum sea-level pressure of 944 mb.

At 1200 on the 21st, a ship located 140 mi northeast of the storm estimated winds at 55 kn and seas of 27 ft (figs. 12 and 13). The September 22 0000 rawinsonde at Ishigakishima (110 mi north-northeast of Betty) showed 70-kn winds from the 3,000-ft through the 18,000-ft level. Upon reaching Taiwan, Betty began to weaken. Her track became west-northwestward as she interacted with a lee-side trough created by the high mountain ranges on Taiwan. Packing winds near 80 kn, Betty crossed into southern Taiwan about 15 mi north of Taitung. Unofficial reports indicated 12 dead, scores injured, and hundreds homeless in the typhoon's wake. Nearly a thousand tourists were stranded as mudslides covered highways. In addition, more than 200 homes were leveled and hundreds of

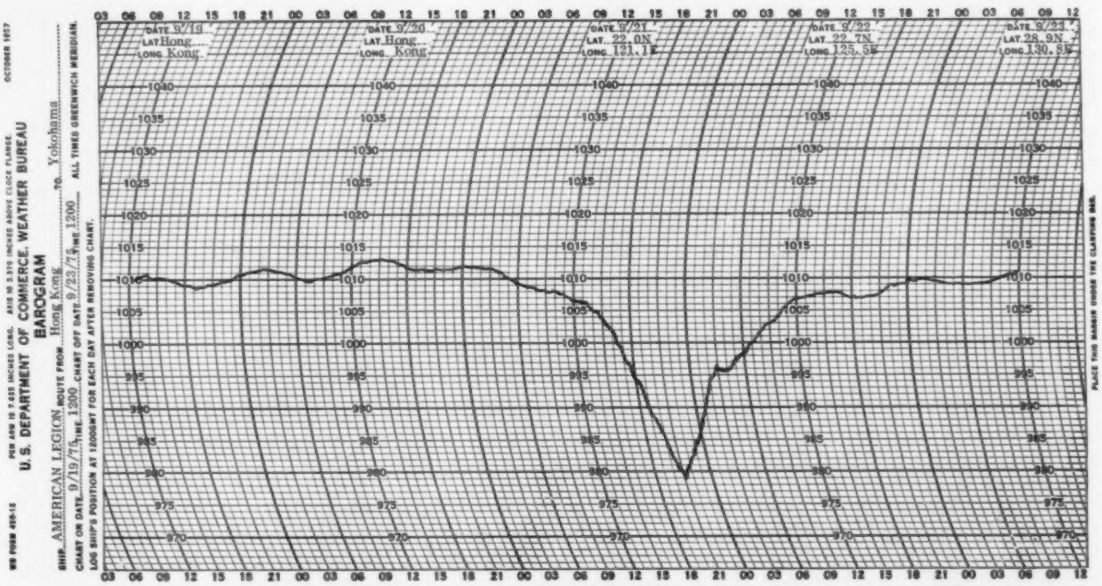


Figure 12. --"Close to you" was the apparent theme of the AMERICAN LEGION as she brushed Betty on the 21st.

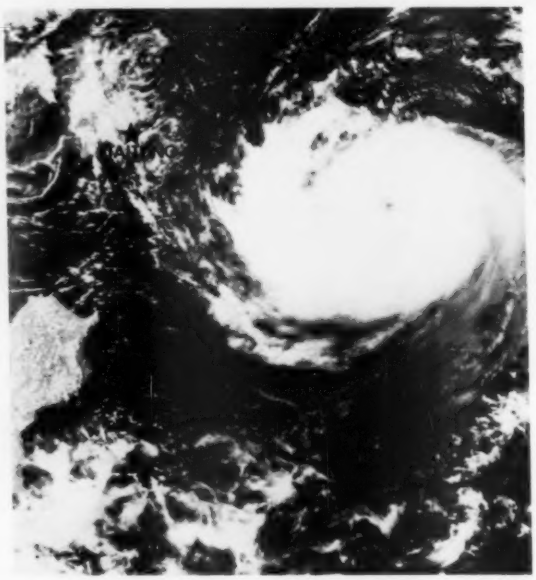


Figure 13. --Betty poses for the camera before going into action against the AMERICAN LEGION at 0315 on the 21st. DMSP Imagery.

others damaged.

After crossing the mountains of southern Taiwan, the storm's track became west-southwesterly. Weakened by the rugged terrain, Betty entered the Taiwan Strait as a minimal typhoon. It continued to weaken and crossed the Chinese coast on the evening of the 23d with 50-kn winds. By the 24th, Betty had degenerated into a low-pressure area some 100 mi north of Hong Kong.

CORA

Weak troughing in the low-level easterlies spawned a disturbance near 10°N, 142°E, on the morning of September 29. This disturbance drifted west-northwestward for the next several days; on October 1, aircraft reconnaissance reported surface winds of 30 kn. Cora was upgraded to typhoon strength on the 3d when aircraft reconnaissance reported 70-kn surface winds and a closed wall cloud. The system lacked good vertical structure through the evening of the 3d when the 700-mb center was still displaced east of the surface center.

As Cora passed 100 mi to the east of Okinawa on the morning of the 4th (fig. 14), Kadena Air Base recorded a peak gust of 31 kn. That evening Cora attained a minimum central pressure of 943 mb and maximum sustained surface winds of 105 kn. Moving to the northeast at 30 kn, Cora passed 120 mi south-southeast of Tokyo on the evening of the 5th. Satellite data on the 6th indicated that there was very little upper-level outflow, but an apparent low-level circulation was still visible. The remains of Cora were now moving to the east at 40 kn as an extratropical system with surface winds of 55 kn.

ELSIE

By the 6th of October, the monsoonal trough had become quite active and was oriented east-west along 8°N from the Philippines to 160°E. Typhoon Elsie developed in this trough with a well-defined surface circulation located approximately 250 mi southwest of Guam on the 8th. Elsie attained typhoon strength on the 10th. At this point, she began slowing down as the

Figure 14.--Cora was generating 95-kn winds around her center, which was about 115 mi east of Kadena Air Base, Okinawa, at 0236 on the 4th. DMSP Imagery.

storm approached the western extent of the mid-tropospheric subtropical ridge. Elsie then underwent explosive deepening, and aircraft reconnaissance recorded a 69-mb drop in the central pressure at the typhoon's center between the 102052 and 111430 fixes. The maximum surface winds increased from 65 kn to 135 kn during this period.

As Elsie approached the Bashi Channel, Basco, in the Bataan Islands, reported maximum sustained winds of 65 kn, 40 mi east of Elsie's center. Elsie continued moving west-northwestward through the Bataan Islands on the 12th. As the typhoon entered the South China Sea, it began to weaken with inflow restricted to the north by the Asian continent. Still, the Royal Observatory in Hong Kong reported that typhoon Elsie was one of the most intense typhoons ever to affect Hong Kong in the month of October. Royal Observatory radar began tracking the storm by late afternoon on the 13th and Elsie passed 35 mi to the south of Hong Kong on the 14th. At that time the maximum sustained winds recorded at Hong Kong were 70 kn with gusts up to 118 kn. Fortunately, the maximum winds occurred at low tide, thus reducing flooding. Seven ocean-going vessels drifted from their moorings, and one small craft and a fishing junk capsized. The lowest pressure recorded in Hong Kong was 987.5 mb. There were no fatalities reported, but 46 people were injured by flying debris.

After passing south of Hong Kong, Elsie continued westward, making landfall on the southern China coast at approximately 1500 on the 14th. Elsie then dissipated rapidly over the Asian mainland.

FLOSSIE

The circulation which was to become typhoon Flossie was first analyzed 500 mi west-southwest of Guam on the 0000 surface analysis of October 14. Its development was somewhat retarded on the 15th and 16th by the presence of a depression 420 mi to the north-northeast. On the 19th the disturbance moved into the South China Sea after crossing Luzon and began to intensify. The first warning was issued on the morning of the 20th based on satellite and synoptic data. Early the next morning reconnaissance aircraft reported a central pressure of 989 mb, and the depression was upgraded to tropical storm Flossie.

A container ship, the MAYAQUEZ, reported a pressure of 980 mb and 60-kn winds on the afternoon of the 21st. At that time the MAYAQUEZ was 40 mi south-southwest of the storm's center. Flossie was upgraded to a typhoon on the afternoon of the 22d when located about 250 mi south of Hong Kong. Two timber freighters, the MING SING and KINABALU SATU, sank between Flossie and the southern approaches to Hong Kong on the 21st and 22d, respectively. Due to the high seas and typhoon-force winds, all rescue efforts failed and a total of 44 men were lost. Three survivors were picked up in a lifeboat a week later.

Flossie reached a maximum intensity of 70 kn on the evening of the 22d. As the typhoon approached landfall on the 23d, its circulation was disrupted in the northeast quadrant by the terrain and its intensity began to diminish rapidly. Flossie made landfall on the afternoon of the 23d on the northeast portion of the Luichow Peninsula. Winds at that time were down to 50 kn.

Although typhoon Flossie's maximum winds were only 70 kn, the seas generated in the northern South China Sea remained a threat to shipping for several days.

IDA

Destined to spend its entire life cycle at sea, Ida was first observed as a tropical disturbance on November 4, 150 mi northwest of Ponape. The disturbance initially tracked westward at 8 kn with dual circulation centers oriented along a northeast to southwest axis. The disturbance became a tropical depression at 0600 on the 6th and then began moving toward the north. Early on the morning of the 8th, the depression was upgraded to tropical storm Ida and accelerated toward the northwest at 10 kn. Ida continued to intensify as the center passed near the southern Mariana Islands, with wind gusts of 32 kn reported on Guam on the 7th. On the 9th Pagan Island in the northern Marianas reported 40-kn winds.

The storm attained typhoon intensity by 1800 on the 9th and began tracking toward the north-northeast at an accelerated rate. A minimum central pressure of 959 mb was observed by aircraft reconnaissance at 1437 on the 10th. By 0000 on the 11th, Ida was moving toward the north-northeast at 33 kn and had lost most of her tropical cyclone characteristics. Twelve hours later, Ida had combined with a frontal system and continued to move rapidly northeastward as an extratropical system.

Figure 15. --Supertyphoon June, at 145 kn, is heading to the northwest, away from Guam, at 2348 on the 19th. DMSP Imagery.

JUNE

June had been under frequent surveillance by satellite and aircraft since her birth in the central Carolines on November 16. Initially, she moved slowly westward, becoming quasi-stationary about 445 mi south of Guam. On the 18th June began to move northward. Simultaneously, she began to deepen rapidly, her surface pressure plummeting 52 mb in 11 hr and 90 mb in 24 hr. By the 19th, the winds of June had increased to an estimated 160 kn as the typhoon reached its lowest pressure some 230 mi west-southwest of Guam. As June tracked north-northwestward her circulation reached exceptionally large proportions. Sustained surface winds of 50 kn or greater extended 200 mi outward from the center.

On the evening of the 19th, June passed approximately 200 mi to the west of Guam (fig. 15). More than 3,200 island residents fled into evacuation centers. There was severe flooding in low-lying areas, with several buildings and homes damaged or destroyed by gale-force winds and storm surge. A peak gust of 70 kn was recorded at Andersen Air Force Base. Island losses amounted to an estimated $300,000 with most of the damage to crops. Eauripik Atoll in Yap district suffered severe property and crop damage. Newspaper reports stated that "sizable portions" of the island were washed away by the heavy seas, but that no deaths or injuries occurred. Flooding and crop damage were also reported on Woleai Atoll and on other low-lying islands in Yap district; however, no casualties were reported on any of the islands.

After passing abeam of Guam, supertyphoon June turned northwestward, but by the 22d she began recurving toward the northeast as maximum winds fell to 100 kn. On the 23d the storm began accelerating rapidly in the strong westerlies and its forward speed reached nearly 60 kn. With an influx of cold air, June became extratropical above 30°N, still possessing winds of typhoon intensity.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US, THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

Mariners Weather Log

TROPICAL CYCLONE FRANCES

A SATELLITE VIEW OF AN UNUSUAL STORM

J. Dane Clark and Thomas G. Burtt
National Environmental Satellite Service, NOAA
Washington, D. C.

Near the end of January 1976, a rather weak tropical cloud system developed in the South Pacific Ocean, east of the Society Islands. The existence of a tropical cloud pattern that far east in the Pacific alerted satellite meteorologists of the Synoptic Analysis Section (SAS) of the National Environmental Satellite Service (NESS) to carefully monitor all ship and island data as well as satellite pictures. Several days later no further development had occurred, but a definite westward track had been established. Ship and satellite data confirmed the presence of a band of rather deep easterlies east of the Society Islands. In addition, movie loops made from a series of pictures taken by the Synchronous Meteorological Satellite (SMS) II revealed little vertical wind shear--a condition generally regarded as favorable for tropical cyclone development.

On February 2, a new tropical disturbance formed in the wake of the first near 20°S, 140°W. This new cloud system formed slightly north and west of the previous one. According to the sea surface temperature analysis based on satellite-derived temperatures and conventional ship data, this cloud system was located over an area of warmer water--another condition which is generally regarded as favorable for further development. Using SMS-II imagery, SAS tropical bulletins indicated that a tropical cyclone was beginning to develop. On February 4, tropical cyclone Frances was born just east of Tahiti.

During the ensuing 5 days, Frances was classified by the SAS using Dvorak's method of tropical cyclone satellite analysis.[1] Careful examination of the classifications made on Frances during its 8-day history revealed a development and decay pattern which characterizes the life cycle of all tropical storms throughout the world.

The evolution of tropical cyclone Frances follows the rapid development curve (as described by Dvorak) and is of interest not only to the meteorologist but to the storm-conscious mariner. The first signs of tropical development occurred on February 2, 1976 (fig. 16). A band of heavy convection about 2° latitude wide, curving cyclonically along with a few alined thunderstorms and towering cumulus clouds, defines an elongated center with a 3° area. According to Dvorak's classification system, the cloud pattern and the poorly defined center characterize a T 0.5. On

[1] A description of Dvorak's system for classifying tropical cyclones, entitled "Tropical Cyclone Intensity Analysis and Forecasting from Satellite Imagery," appeared in the July 1975 issue of the Mariners Weather Log, Vol. 19, No. 4, pp. 199-206.

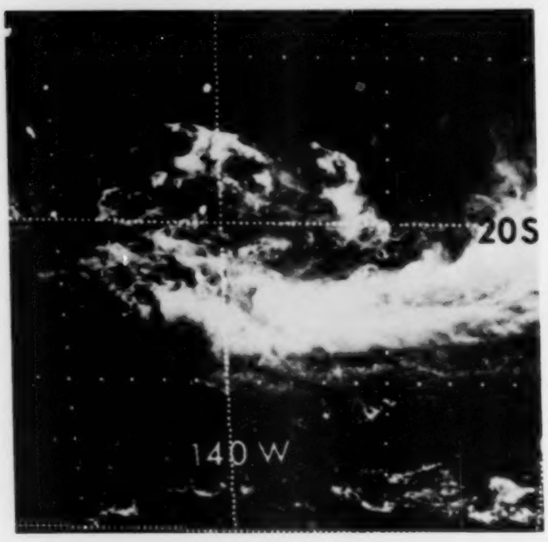


Figure 16.--1900 GMT February 2, 1976 - T 0.5.

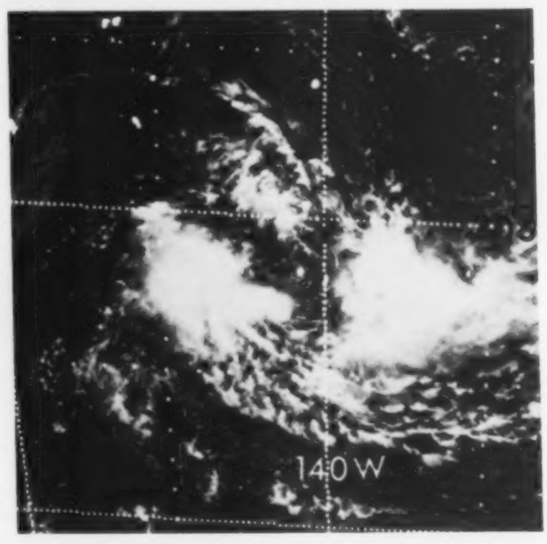


Figure 17.--1900 GMT February 3, 1976 - T 1.0.

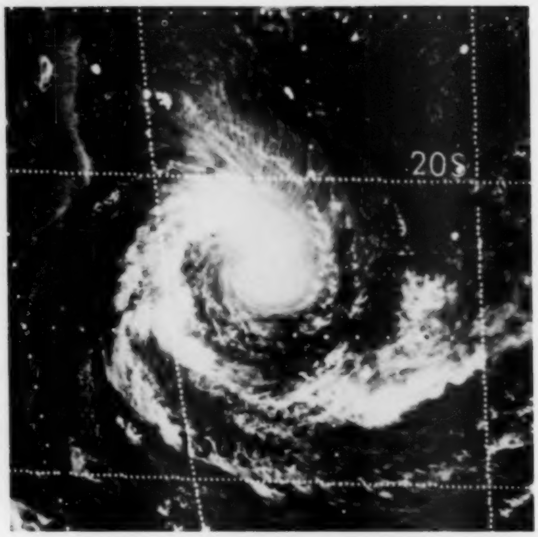


Figure 18.--1900 GMT February 4, 1976 - T 2.5.

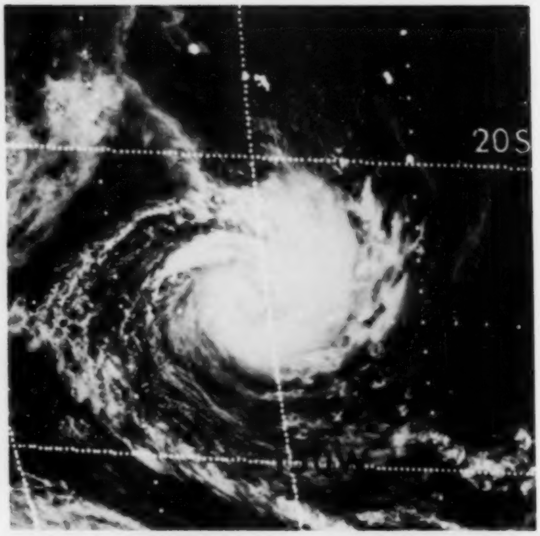


Figure 19.--1900 GMT February 5, 1976 - T 4.0.

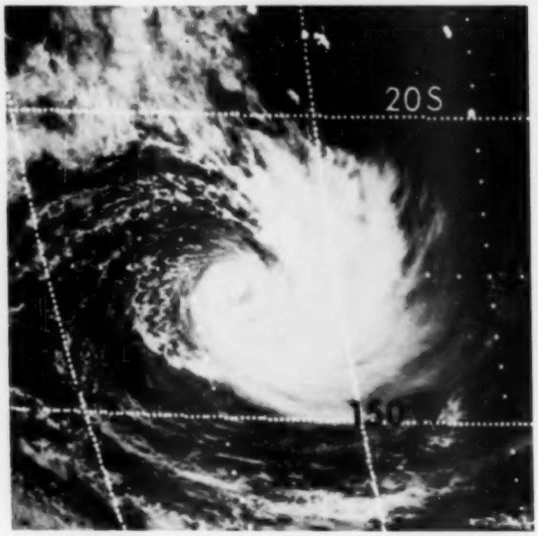


Figure 20.--1900 GMT February 6, 1976 - T 4.5.

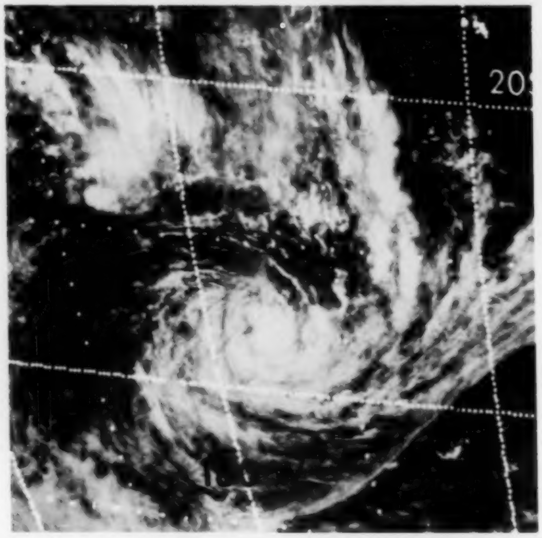


Figure 21.--1900 GMT February 7, 1976 - T 3.5/ CI 4.5.

February 3 (fig. 17) development has occurred during the past 24 hr. The alined rows of thunderstorms and towering cumulus define the center within a much smaller area, less than 2°, thus making it a T 1, with a maximum windspeed (MWS) of 25 kn. By February 4 (fig. 18) a dramatic change in the cloud pattern has occurred. The center has become more well defined underneath a hard central dense overcast at the tip of a large comma-shaped cloud, and a cyclonically curved band of convection is observed to emanate from the dense overcast in the northwest quadrant. A close inspection of the satellite picture indicates thunderstorms, towering cumulus, and cumulus cloud lines spiraling around the center, indicating the overall strength of the system. At this time a classification of T 2.5 is indicated, thus showing rapid development in the past 24 hr, and a MWS of 35 kn. On February 5 (fig. 19) the cloud pattern seen in the satellite imagery indicates that continued rapid development has taken place during the past 24 hr. A banding type eye is quite evident, near 25°S, 151°W, along with a wide band cradling the eastern portion of the central feature. This classic T 4 system indicates a MWS of 65 kn. On February 6 (fig. 20) the eye is more distinct,

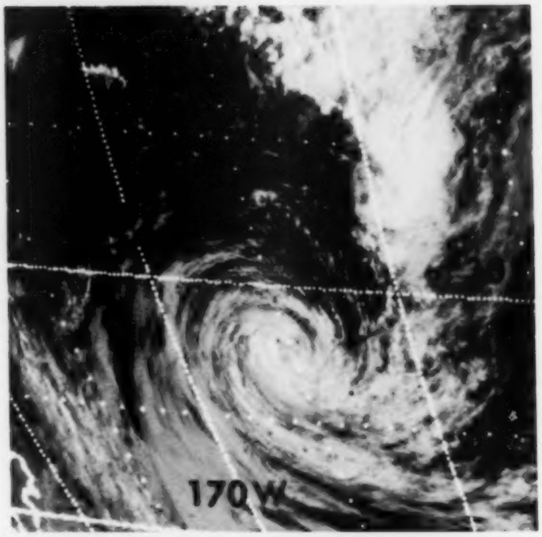


Figure 22.--1900 GMT February 8, 1976 - T 2.5/ CI 3.5.

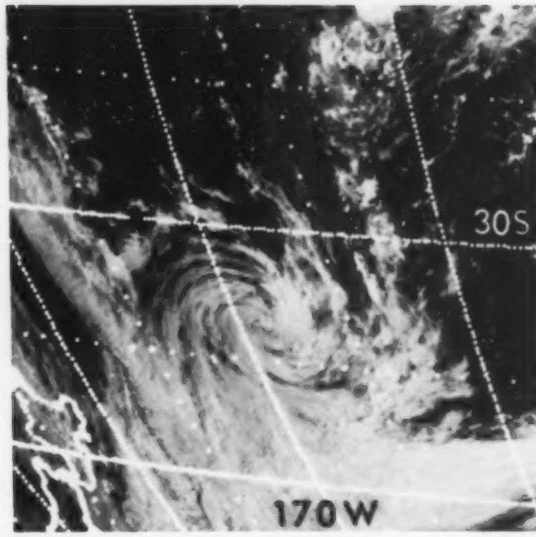


Figure 23.--1900 GMT February 9, 1976 - T 1.5/ CI 2.5.

and the banding feature is longer, wider, and more quasi-circular. With this embedded distance it is a typical T 4.5 (MWS 77 kn). On February 7 (fig. 21) the storm has passed its peak and is weakening. This is evident by the decreasing amount of convection, the loss of the solid heavy wide band, and the fact that the eye is no longer discernible. The tight curvature defining the center of the system and the small amount of banding are typical of a T 3.5/CI 4.5. However, because of the observed lag between cloud dissipation and the decrease in mean windspeed (possibly because of the conservation of momentum), current intensity (CI) is still approximately 4.5 (77 kn). On February 8 (fig. 22) a continued southwesterly motion over colder water has weakened the storm to a T 2.5/CI 3.5 with a well-defined center still evident in the low clouds. However, the amount and density of the heavy convection is less, and the convective banding is not as wide or quasi-circular. This weakened condition indicates a MWS of 55 kn. Finally, on February 9 (fig. 23) the storm has continued to move southwestward and has weakened rapidly while beginning to merge with an extratropical system. The amount of convection diminishes as it becomes extratropical. However, the apparent well-defined center requires a classification of T 1.5/CI 2.5 and a resultant MWS of approximately 35 kn.

Examining satellite data over the past 12 yr, only one other tropical cyclone has been observed in the vicinity of the Society Islands. This cyclone, which occurred in late January 1970, reached a maximum intensity of T 3.5 (55 kn) while on a southeasterly track. This tropical cyclone, as well as other subtropical cyclones tracking eastward, developed in a persistent cloud band east of an upper atmospheric trough between the dateline and the Society Islands. Most of these subtropical cyclones have maximum windspeeds of less than 50 kn. Tropical cyclone Frances was not only the strongest cyclone in the past 12 yr (T 4.5, 77 kn) but the only one to move on a westward track (fig. 24).

Under normal conditions, the area around the Society Islands is on the eastern side of the mean upper tropospheric trough which produces winds with a westerly component in the higher levels. The area is also north of the low-level subtropical ridge position which leads to easterlies in the lower troposphere. The resultant mean vertical wind profile reflects Gray's studies which show that this area is normally under the influence of a strong zonal wind shear between 850 mb and 200 mb. The reason for the lack of tropical storm development in this area may be the result of the strong vertical wind shear and unfavorable sea surface temperatures (< 26°C).

During the life cycle of tropical cyclone Frances there were two important departures from normal

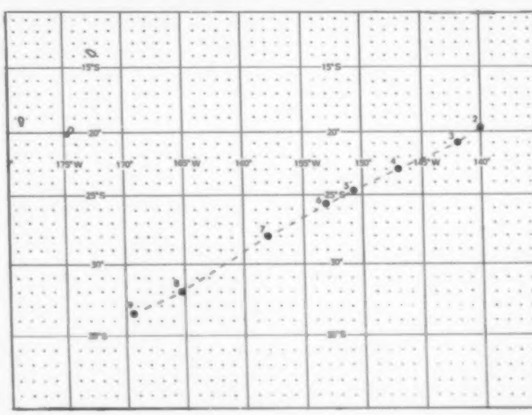


Figure 24.--Track of cyclone Frances. All positions are 1900 GMT from February 2-9, 1976.

conditions. (1) The sea surface temperature measured by satellite and ship observations was near 27°C which is 1° to 2°C warmer than normal and greater than the 26.5°C minimum temperature needed for tropical storm development. (2) Examining the satellite movie loops, as well as the tracks of Frances and the weak preceding disturbance, it appears that the lower tropospheric easterlies extended well up into the middle and upper troposphere. This extension of the easterlies upward was probably the main explanation of the light vertical wind shear observed as tropical cyclone Frances was developing. It is likely that these two anomalies were responsible for such a rapid development in a normally unfavorable area.

REFERENCES

Dvorak, V. F., "Tropical Cyclone Intensity Analysis and Forecasting from Satellite Imagery," Mariners Weather Log, Vol. 19, No. 4, July 1975, pp. 199-206.

Gray, W. M., "Global Views of the Origin of Tropical Disturbances and Storms," Monthly Weather Review, Vol. 96, No. 10, October 1968, pp. 669-700.

Hints to the Observer

DIURNAL PRESSURE VARIATION AND TROPICAL CYCLONE DEVELOPMENT

Similar to ocean tides, atmospheric pressure rises and falls twice a day. This pressure "tide" is called diurnal pressure variation. During each 24-hr period two highs occur, one at approximately 1000 and the other at 2200, local time. The two lows occur at approximately 0400 and 1600, local time. The range of the diurnal pressure change is greatest in tropical areas and becomes smaller toward the middle and higher latitudes. In the middle and higher latitudes, the movement of storm centers during much of the year causes such large changes in pressure that the normal diurnal variation is masked. In tropical waters, however, the barograph trace will usually show the familiar sine curve, with two crests and two troughs during a 24-hr period, as illustrated in the barogram (fig. 25).

In the Tropics, changes from the normal diurnal pressure pattern may indicate formation of a tropical cyclone. The usual signs are that the minimum trough of the barograph trace or other pressure record is much deeper, or that the maximum fails to develop. By use of the barograph and reference to one of the marine atlases it is possible to tell whether or not the change from the normal diurnal value is significant. Under normal conditions the diurnal variation should oscillate about the mean pressure value. Whenever the diurnal value drops 3 to 5 mb below the mean pressure during the hurricane season, a tropical cyclone is probably developing in the area. Figure 25 shows a normal range of diurnal pressure variation for tropical latitudes. Note the drop in pressure prior to the normal crest of the diurnal high and the sharper than normal drop in pressure as the PRESIDENT MADISON approached tropical storm Agatha. Other significant weather parameters should be observed, depending on the location of the ship, such as a change in the wind direction to a westerly component or higher than the normal windspeeds; an increase in shower activity which tends to persist; and an increased swell pattern or a swell pattern moving from an unusual direction for the particular waters.

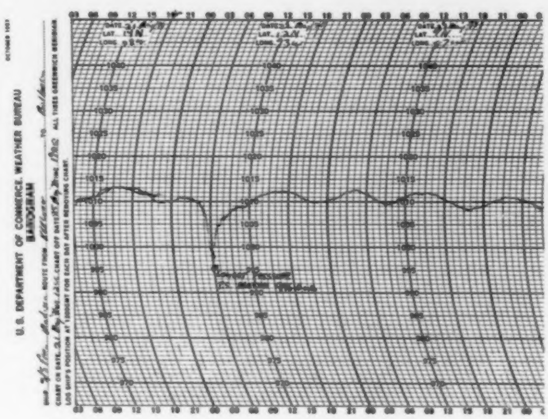


Figure 25.--Barogram of the PRESIDENT MADISON showing normal diurnal pressure variations and pressure drop when Agatha was encountered.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

Tips to the Radio Officer

Thomas H. Reppert
National Weather Service, NOAA
Silver Spring, Md.

The Coast Guard Radio Station (NMH), Washington, D.C., ceased all weather broadcasts on July 1, 1976. Its responsibilities have been assumed by the newly expanded Coast Guard Communications Station (NMN), Portsmouth, Va.

The Radio Officer aboard the MAINE reports radioteleprinter broadcasts from WBR, Miami, Fla., and ZRO, Pretoria, South Africa, are transmitted at 100 words per minute.

CORRECTIONS TO PUBLICATION, WORLDWIDE MARINE WEATHER BROADCASTS, 1975 EDITION

Page 7--Add new station: NSS Annapolis, Md. Times and area same as NAM. Frequencies 8090, 12235.
Add new station: NAR Key West, Fla. Times and area same as NAM. Frequencies 5870, 25590 at 1200-2400 only.
NMA: Add letter "G" under contents column. Gulfstream analysis at 0100, 1600.

Page 8--WPD: Delete all.
PZN: Delete frequency, insert 488.

Page 9--Add new station: GXH Thurso, Scotland. Same times and area as NAM with naval broadcast for northern and eastern Atlantic and Mediterranean Sea at intervening times. Frequency 3724 at 1900-0800 only.
PJC: Delete frequency 6894, insert 8694.

Page 10--NST: Revised schedule:

0030, 1230	7504.5 12691, 0800-1900 only	W, A
0630, 1900	do	W, F
0500, 1700	do	IB

Area: North Atlantic west of 35°W including Gulf of Mexico and Caribbean Sea. Naval broadcast at intervening times includes northern and eastern Atlantic and Mediterranean Sea.
Add new station: NRK Reykjavik, Iceland. Times and area same as NST. Frequency 5167.

Page 11--Add new station: AOK Rota, Spain. Times and area same as NST. Frequencies 5917.5, 7705.
CTD: Delete frequency 3838, insert 3620.
PCH: Delete times, insert 0918, 1518, 2118.

Page 12--Add new station: NGR Athens, Greece. Times and area same as NST. Frequencies 4623, 13372.5 0800-1900 only.

Page 15--XXV: Delete all.
ZSC: Add frequency 22455.

Page 16--KFS: Add area 3 in area c.
KOK: Delete area 6.

Page 17--Top of page should read NORTH PACIFIC OCEAN.
NOX: Delete all.
VAI: Add frequency 8435 after June 1, 1976, in place of 8722.

Page 18--Add new station: NRV Guam, Marianas Is.

0000, 0800	406	W

Area: local waters.
NPN: Add footnote 4. "used only by NDT."

Page 19--Top of page should read NORTH PACIFIC OCEAN.

Page 21--Top of page should read NORTH PACIFIC OCEAN.

Page 23--Stations NPN, KHK, and NMO broadcast weather for South Pacific Ocean.

Page 24--VIX: Delete frequency 44.
VIA: Delete times 0118, 1248, insert 0048, 2248. Add frequency 6463.5.
VIM: Delete times 0048, 1318, insert 0918, 2218. Add frequency 4245.
VIB: Delete times 0118, 1248, insert 0948, 2318. Add frequency 6351.2.
VIR: Delete time 0130, insert 0048. Add frequency 6502.
VIT: Delete time 0048, insert 0030, 0930, 2348.

Page 25--Top of page should read SOUTH PACIFIC OCEAN.
VII: Add times 0018, 0918. Add frequencies 488.5, 6502.

Page 26--CRX: Delete all.

Page 27--GZC: Delete all.
Add new station: 3BM Mauritius. Times 0130, 0430, 0900, 1330, 1630, 2030. Frequencies 6351.5, 12988.5, 16978.4.

Page 29--VIP: Delete frequencies 8598, 6407.5, insert 8597.5, 12993.
VIO: Delete time 1248, insert 1230.
VIE: Delete time 0040, insert 0048, 1148. Add frequency 6407.5.

Page 30--VIN: Delete all.

Page 35--WOO: Add time 1900.
NMH: Gulfstream analysis at 1600, 2200. This station closed July 1, 1976. Operations transferred to NMN Portsmouth, Va. Same times and frequencies.

Page 37--VAU: Delete frequency 161.65.
NMK: Add frequency 157.1, May 15 to October 15.
NMY-41: Delete frequency 157.1.

Page 38--WOM: Add 30 min to all broadcast times.
WMH: Delete all.
WGB, NMN, NMN-37: Substitute "Cape Henlopen" wherever "Cape May" appears in area description.

Page 39--NMG: Add times 1050, 1650, 2250 and frequency 157.1.
WLO: Add frequency 161.90.
NOF: Area b should read "Coastal waters Tarpon Springs to Apalachicola including Florida Straits." Add F to contents column.

Page 40--Add new station: NMG-15 Grand Isle, La.
Area: Coastal waters Biloxi, Miss., to Morgan City, La.

1045, 1645, 2245	157.1	F

Add new station: NOY-3 Port Aransas, Tex.
Area: Port Arthur, Tex., to Brownsville, Tex.

1040, 1645, 2245	157.1	F

Page 41--OXF: Delete footnote 1.
ZBM: Add times 0118, 0518, 1318, 1718 and frequency 157.3.

Page 44--PCH: Delete all times and insert 0340, 0940, 0945, 1540, 1545, 2140, 2145. Add frequency 1862.

Page 47--WWV: Add frequencies 2500, 20000, 25000.
KMI: Delete all times and insert 0000, 0600, 1800. Delete all frequencies and insert 4371, 8738.4, 8735.2, 13161.5, 13151, 17307.5. Delete footnotes 2 and 4.
KCI-94: Delete all.
NMJ-21: Add areas 12 and 13.

Page 48--KGD-91: Delete time 2300, insert 1800 and 2000.
KCI-97: Delete time 2125, insert 2325.
WGG-56: Add times 0430 and 1430.
WGG-58: Add times 0430 and 1430.
Add new station: WRN-43 Mud Bay, Alaska.
Area: Coastal waters southeastern Alaska, Dixon Entrance to Cape Fairweather.

0230, 0430, 1430, 1630, 2100	162.0 (F3)	F

Add new station: WDU-29 Sitka, Alaska. Same time and frequency as WGG-58.
Add new station: WRN-42 Petersburg, Alaska. Same time and frequency as WRN-43 Mud Bay, Alaska.
Add new station: WRN-41 Ketchican, Alaska. Same time and frequency as WRN-43 Mud Bay, Alaska.
Add new station: WRN-40 Lena Point, Alaska. Same time and frequency as WRN-43 Mud Bay, Alaska.

Page 49--VAJ: Delete time 1300, 2200, insert 1305, 2150.
VAH: Delete times 0500, 0900, 2230, insert 0520, 0910, 2220.
VAF: Delete time 1320, insert 1405.
VAE2: Delete time 1420, insert 1425.
VAE: Delete times 1330, 1440, 1930, insert 1335, 1445, 1950.
VAC: Delete all times, insert 0020, 0435, 1435, 1720, 2040.
VAI: Delete time 1310, insert 1315.
VAK: Delete all times, insert 0320, 1250, 1415, 2010.

Page 50--NMW: Add time 1203.
KQX: Delete all.

Page 51--Add new station: NRV Guam, Marianas Is.
Area: local waters.

1005, 2205	2670 (A3H)	W, F
0730, 2330	157.1 (F3)	W, F

Page 52--Stations WWVH and KQM broadcast weather for South Pacific Ocean.
3DP: Delete 0403, insert 0433.
VIA: Delete frequencies, insert 2201, 4136.3.
VIM: Delete frequency 2148, add 2201, 4136.3.

Page 53--VIS: Delete frequencies 6204, 6410, insert 4136.3.
VIB: Delete frequencies 2148, 6204, 6410, insert 4136.3.
VIT: Delete times, insert 0333, 0748, 2133. Delete frequencies, insert 2201, 4136.3.
VII: Delete times, insert 0248, 0648, 2303. Delete frequencies, insert 2201, 4136.3.
VID: Delete frequency 6410, insert 4136.3.

Page 54--VIO: Delete times, insert 0903, 2333. Delete frequencies, insert 2201, 4136.3.
VIC: Delete frequency 6204, insert 4136.3.
VIE: Delete time 0118, insert 0103. Delete frequencies, insert 2201, 4136.3.

CORRECTIONS TO PUBLICATION, RADIO STATIONS ACCEPTING SHIPS' WEATHER OBSERVATIONS

Pages 5 - 7--NMF: Delete 8728, insert 8459.
NMC: Delete 17218.5, insert 16889.9.
NMO: Delete 17247.8, insert 16909.7.

ACKNOWLEDGMENT OF CORRESPONDENCE

Thanks to Rae A. Echols, SS MAINE; Charles J. Kapoesy, SS AMERICAN LEGION; Juveail Helios Guaza, RIO LIMAY, for recent information concerning the Marine Weather Program.

Hurricane Alley

Dick DeAngelis
Environmental Data Service, NOAA
Washington, D. C.

The total of seven Southern Hemisphere tropical cyclones was a little less than normal for March and April. Only two reached hurricane intensity. The North Indian Ocean spawned just one tropical storm during the 2-mo period. The storm tracks and summaries are based on information provided by the National Environmental Satellite Service, warnings from the Navy Fleet Weather Central at Guam, and tropical analysis charts from the National Meteorological Center. Tracks for the March and April tropical cyclones appear in figure 26.

SOUTH INDIAN OCEAN - MARCH AND APRIL

Two tropical cyclones developed in March, one in April. Both March storms disturbed the weather in the Mozambique Channel. Both formed east of the Malagasy Republic. The earlier storm passed through the Comoro Islands where Mayotte Island reported a northeast 65-kn wind and a 989-mb pressure at 0000 on the 12th. The hurricane moved ashore near Porto Amelia, Mozambique. The later storm moved across the Malagasy Republic (fig. 27) and into the Channel on the 30th. This landfall prevented the storm from reaching hurricane strength; her maximum winds had climbed to 60 kn before she moved ashore near Antalaha. The April tropical storm was christened Bert by the Australians, even though it was far from their shores. Bert reached a peak from the 5th through the 7th when winds near his center were estimated at 40 to 45 kn.

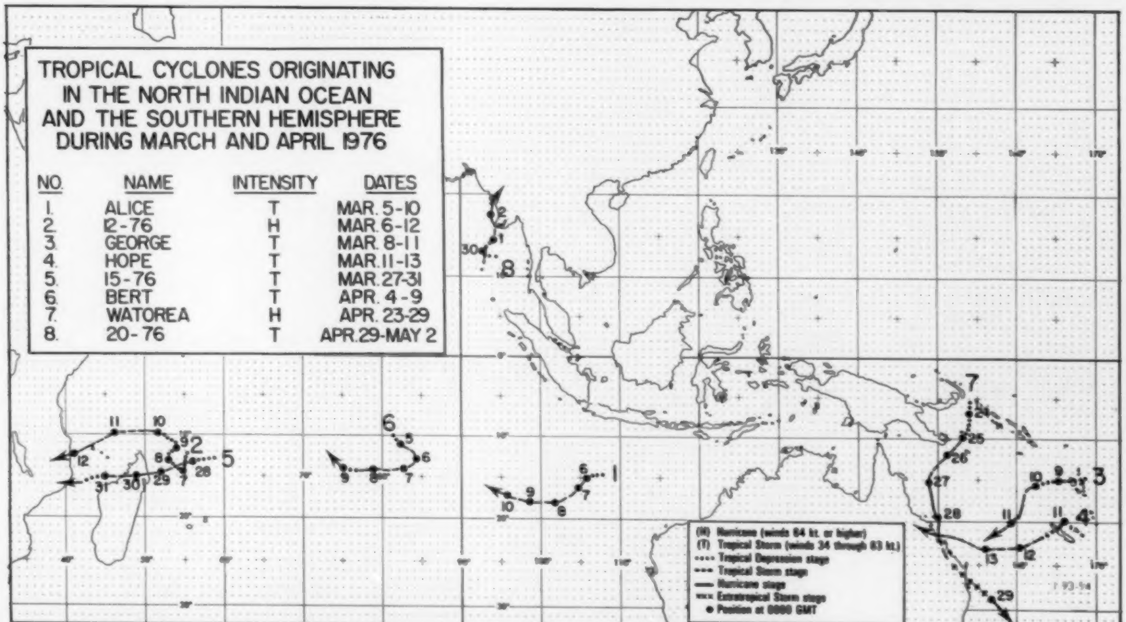


Figure 26.--Tracks of tropical cyclones in the North Indian Ocean and the Southern Hemisphere during March and April 1976.

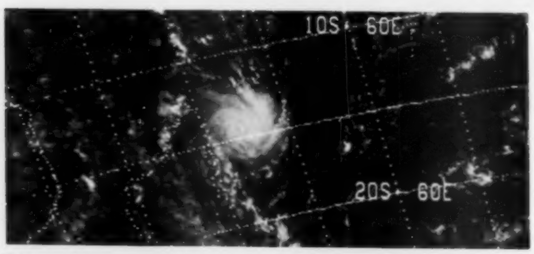


Figure 27.--Tropical storm hits Malagasy coast on 29th.

SOUTH PACIFIC-AUSTRALIA REGION
MARCH AND APRIL

Watorea was the only hurricane. She formed near the particularly low latitude of 5°S, just east of New Britain on April 23. She was rightfully claimed

by New Guinea. Watorea reached hurricane intensity by the 26th. The following day Willis Island reported 45-kn winds as the storm passed to the west (fig. 28). Near her center winds were estimated at 75 kn. Watorea skimmed across the Queensland coast and back into the Coral Sea on the 28th.

Alice, George, and Hope all developed in early March, lasting just 3 to 6 days. Alice spent her life cruising westward to the south of Christmas and Cocos Islands. On the 8th the ALTHAM, sailing 60 to 100 mi south of her center, encountered 15- to 20-ft swells. George and Hope formed among the New Hebrides Islands within a few days of each other. In fact, there is some confusion as to whether these were two separate storms. Neither developed much beyond minimal tropical storm strength as they moved across the Coral Sea toward Australia. On the 13th the NEW GUINEA CHIEF encountered 30-kn winds in 12- to 15-ft swells about 100 mi southwest of Hope's center.

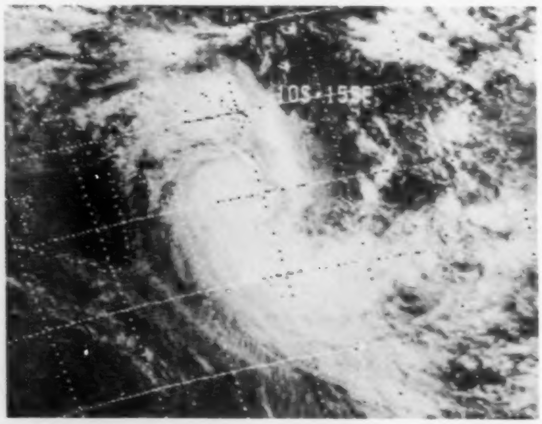


Figure 28.--Hurricane Watorea lies off the coast of Queensland late on the 26th.

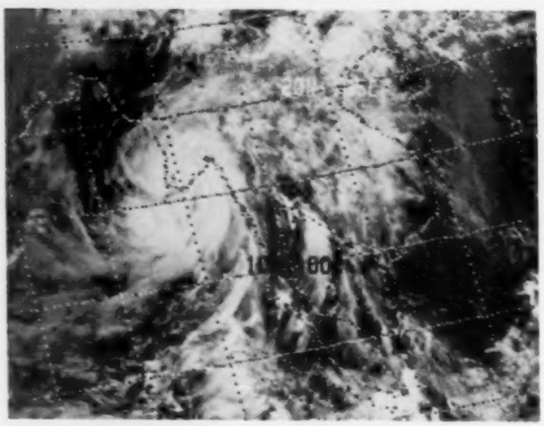


Figure 29.--The cyclone batters the Rangoon area of Burma.

NORTH INDIAN OCEAN - MARCH AND APRIL

This normally active 2-mo period was about to come to an inactive end when a tropical cyclone came to life on the 29th of April. Forming in the Andaman Sea, it moved slowly northward and intensified. By May 1 winds near the center were blowing at about 50 kn with gusts to 65 kn. The following day the storm moved ashore near Sandoway, Burma (fig. 29).

NORTH INDIAN OCEAN TROPICAL CYCLONES, 1973

This brief summary and the storm tracks for the 1973 season were based on an article appearing in the Indian Journal of Meteorology and Geophysics entitled "Cyclones and Depressions of 1973 - Bay of Bengal and Arabian Sea" by George Alexander, C. A. George, and R. Jambunathan of the Meteorological Office in Poona (July and October 1974, Volume 25, Nos. 3 and 4).

Five tropical cyclones formed in the Bay of Bengal while one developed in the Arabian Sea in 1973. Three of the storms reached severe intensity (winds $\geq$ 48 kn). The first storm occurred in the Arabian Sea during the spring season, while the others were confined to the Bay of Bengal and were spawned during the fall. Table 8 is a brief summary of the season, and figure 30 shows the tracks.

Table 8.--North Indian Ocean tropical cyclones, 1973

No.	Date	Maximum winds (kn)	Lowest pressure (mb)	Remarks
1	June 6-12	38	991	
2	Oct. 6-12	45	996	affected Chandbali; rainfall amounts up to 23 in; caused widespread flooding.
3	Nov. 3-9	75	982	affected Paradeep; waves off coast reported at 10 to 15 ft.
4	Nov. 14-17	55	994	
5	Dec. 5-9	60	990	15-ft storm tides near Barisal; the SONAVATI sank with 10 crewmembers dead.

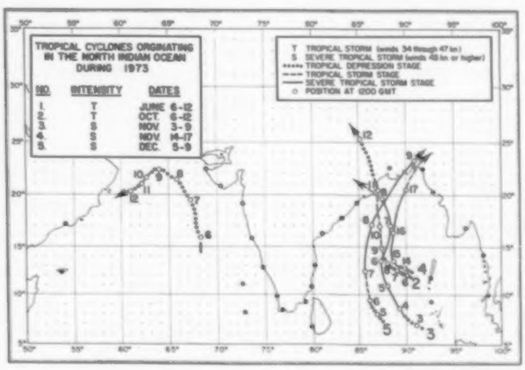


Figure 30.--Tracks of tropical cyclones originating in the Indian Ocean, 1973.

On the Editor's Desk

PROBLEMS WITH OBTAINING NIGHTTIME SHIP WEATHER REPORTS

Editor's Note: The following item was received from Robert Schoner, Marine Program Manager of the Data Systems Division, National Weather Service, NOAA. It should be of interest to all cooperating observers and radio officers.

National Weather Service forecasters who use surface ship reports from the vast oceanic areas for preparing forecasts and warnings are often faced with the lack of important observational data at crucial times. A wealth of weather information along the principal shipping lanes during daylight hours diminishes to a few scattered reports during the hours of darkness. Widely different reports from ships in one area make it difficult to decide which one represents true conditions. These marine data acquisition deficiencies contribute, at times, to NWS (NOAA) inability to issue accurate marine forecasts and warnings for its area of responsibility. The U.S. is responsible for forecasts and storm warnings to shipping under the Safety of Life at Sea Convention in agreements with the World Meteorological Organization. The U.S. area of responsibility is west of 35°W and north of 3°N in the Atlantic and east of 180° and north of the Equator in the Pacific.

The volume of ship reports available to weather forecasters is small compared to the number actually taken by ships' officers. Less than half of those taken by ships' deck officers reach the marine forecaster. Messages are not transmitted because of (1) restricted watch hours aboard "one radio" operator ships, (2) inability to contact the limited number of shore radio stations accepting and relaying weather observations, and (3) breakdown or inadequate communications between relay stations and National Meteorological centers. This communication problem could be relieved by the establishment of a dedicated communication data collection system. Such a system is only possible by using satellite communication systems (GOES, MARISAT, etc.). The problem could be reduced further by allowing the deck officer to enter observations directly into the system, or by interfacing a fully automated shipboard weather reporting system with satellite. Unfortunately, a fully automated weather reporting system is not available. There is still need for manual observations of clouds, sea conditions, visibility, and ship course and speed to determine true windspeed and direction.

Another solution which is in practice but not entirely successful is to pay radio officers overtime when they make nighttime transmissions. Under the existing overtime contract program NWS receives an average of 4 to 5 Atlantic (0600Z) overtime reports per day and 18 to 20 Pacific (1200Z) reports per day. These nighttime reports do not provide enough information to make them worthwhile in the Atlantic and are of limited help in the Pacific. At the current cost to the NWS for overtime reports it would take over $1 million per yr to get equal data coverage at night as is obtained during the day. Even if money were available, it is difficult to obtain the cooperation needed from the number of ships necessary to provide these reports.

All methods for getting nighttime ship reports are extremely expensive. Dedicated communication methods and automated shipboard weather stations require purchase and installation of costly equipment. The most difficult problem foreseen for automation is maintenance to keep the costly equipment operating in the hostile marine environment.

NWS is faced with the ultimate solution being some form of automation, but it will be necessary to continue with the contract for nighttime reports for a while. To get the best results NWS plans to concentrate in the Pacific and drop Atlantic overtime commitments. NWS plans to negotiate with shipping companies and maritime unions to find the most economical means to collect the vital ship reports to support its Safety of Life at Sea commitments.

NEW PMO FOR CANAL ZONE

Robert L. Melrose (fig. 31) recently assumed duties as the National Weather Service Port Meteorological Officer at Cristobal, Canal Zone. He has had a varied meteorological career, serving from almost Pole to Pole.

Mr. Melrose served with the U.S. Navy from 1957 to 1962, at the Fleet Weather Central, Suitland, Md., and aboard ship out of Norfolk, Va. On his honorable discharge from the Navy in 1962, he joined the National Weather Service, Overseas Operations Division, and was stationed at three sites in the Northwest Territories of Canada and at Hallett, Antarctica. Also, during this time he was assigned as field representative to the National Science Foundation at Christchurch, New Zealand.

On returning to the Northern Hemisphere Robert had a brief assignment in Alaska before joining the U.S. Naval Postgraduate School, Monterey, Calif., in late 1967. From 1969-71 he was stationed on Wake Island. Returning to the United States, he was with the cooperating ship Expendable Bathythermograph (XBT) Program out of California. He returned to the Atlantic in 1974 for 2 yr at the Weather Service Office on Islas del Cisne (Swan Island) from where he was selected as the new Port Meteorological Officer at the Canal Zone.

Mr. Melrose has received several awards, including the honor of having "Melrose Peak" in the Churchill Range, Antarctica, named for him by the Board of Geographic Names.

Figure 31. --Robert L. Melrose.

TELEPHONE NUMBER CANAL ZONE PMO

The correct telephone number for contacting the Port Meteorological Officer in the Panama Canal Zone is 431565. Mr. Robert Melrose has recently assumed these duties.

NEW AIRCRAFT FOR ENVIRONMENTAL RESEARCH, WEATHER MODIFICATION

The second of two new WP-3D Orion aircraft (fig. 32) purchased by NOAA was delivered to representatives of the Commerce Department agency at the Lockheed-California Company's Burbank plant on Friday, January 30.

The $7 million flying laboratory was accepted for NOAA by the senior scientist with the Weather Modification Program Office in NOAA's Environmental Research Laboratories. The airplane, designated N43RF, will be operated by that office's Research Facilities Center in Miami, Fla.

When fully instrumented in 1977, "NOAA Forty-three" will join an historic squadron of research aircraft in a broad range of environmental missions, including studies of severe storms, cumulus cloud and hurricane modification, air-sea interactions, air quality, and weather and climate. NOAA project scientists view the arrival of the two Orions as a major milestone for research meteorology.

The WP-3D resembles the turboprop transport Electra, although the resemblance is superficial--the tougher, more powerful Orion series was developed to carry out the U.S. Navy's antisubmarine warfare and weather reconnaissance missions. Since 1959 more than 400 Orions have been built and today serve with the U.S. Navy and the defense forces of Australia, Canada, Iran, New Zealand, Norway, and Spain.

The main visible differences between the NOAA airplane and its Navy cousins are additional bubble and passenger windows in the fuselage and belly and tail radomes.

The Orion is powered by four Allison turboprop T-56-A-14 engines, each rated at 4,910 equivalent shaft horsepower. It can operate effectively from sea level to 30,000 ft (9,100 m) and loiter at speeds between 180 and 225 kn (355 and 415 km/hr).

NOAA Forty-three carries a crew of 4--pilot, copilot, flight engineer, and navigation-communication operator--and a mission crew of 12 scientists, technicians, and observers. Seats are also available for five passengers.

In the NOAA configuration, the aircraft has a maximum range under cruise conditions and four-engine operation (with a 12,000 lb pay load) of more than 3,600 mi (6,700 km), with a 2-hr fuel reserve. It can conduct research measurements 650 mi (1,200 km) from a takeoff base for 8 hr at 28,000 ft (8,500 m) altitude, with a 2-hr fuel reserve remaining upon return to base. The airplane also can operate for 7 hr at 5,000 ft (1,500 m) or 6.5 hr at 1,500 ft (450 m) while 650 mi from base.

A WEATHER SERVICE REMINDER: HURRICANE SEASON IS HERE

Editor's Note: The information below is published in the interest of safety of all readers. A very large percentage of our readers are from coastal regions, and generally the families of the ship's crew are located at or near coastal areas. A hurricane or tropical storm watch or warning should be closely monitored and heeded and the safety rules followed. The life you lose could be your own or your family's.

Figure 32.--An artist's conception of the WP-3D flying laboratory in a hurricane.

Hurricane season began in June. Once again NOAA has advised U.S. coastal residents from Texas to Maine to start getting ready. The months of peak frequency for the giant pinwheel-shaped storms are August, September, and October. The season lasts through November 30.

It has been almost 7 yr now since a hurricane caused a major loss of life on the U.S. coastline, when, in August 1969, hurricane Camille roared into Mississippi and Louisiana, causing 144 deaths. Forecasters of NOAA's National Weather Service are growing increasingly apprehensive about public apathy.

Their concern is magnified by the mushrooming population in coastal areas around the Gulf of Mexico and along the Atlantic Seaboard and further increased by the very low level of hurricane experience in that population.

Dr. Neil Frank, Director of the National Hurricane Center at Miami, Fla., is spearheading an effort to arouse public awareness of the danger. He quotes a report prepared by the University of Colorado for the National Science Foundation showing that U.S. Gulf and Atlantic coastal populations increased 40 percent during the decade ending 1970, compared to 12 percent for the nation as a whole. Dr. Frank says almost 80 percent--28 million out of 36.5 million people--in the 1970 coastal population had never experienced a major hurricane. Now, that proportion is undoubtedly even higher.

The greatest concern is that people will underestimate the lethal effects of hurricanes, either out of ignorance or because they once went through a mild storm, or saw only the fringe effects of a major one.

It is for this reason that U.S. forecasters are constantly reminding people that it was a hurricane which produced the worst natural disaster ever to strike the North American continent--a 15-ft tide of wind-driven water that totally devastated Galveston Island, cutting off escape to the Texas mainland, and drowning 6,000 people, on September 8, 1900.

With this and other grim reminders, forecasters hope to avert another such disaster. They believe that, if they do not speak out, growing population pressures in hurricane-prone areas may cancel out the benefits of satellites, reconnaissance aircraft, radar, and constantly improving forecast techniques which have made the U.S. hurricane-warning service the best in the world.

It is of vital importance that attention be focused on actions that must be taken by coastal residents if they are to escape from hurricanes. Historically, the primary means has been the automobile, but traffic engineers tell us road systems may not be able to handle the volume of traffic to evacuate many of our beach developments.

One case in point is the summer tourist traffic along the southern New Jersey shore. Another vulnerable area is the Florida Keys, served by a narrow, two-lane road. If a travel trailer overturned and blocked one of the bridges on the Keys during a hurricane evacuation, it could tie up traffic for hours, trapping thousands of people only a few feet above sea level as the water rose. The results could be calamitous, because people would have no place to go. Our effort to meet this threat is a certain amount of overwarning; there is no other choice.

In other places with limited escape routes, there are large, high-rise apartment buildings and condominiums that could be designated as hurricane shelters. If we knew that everyone could relocate to a vertical refuge within a few hours, we could restrict greatly the area warned and also the size of the area evacuated.

Whatever the solutions, the vulnerable coastal populations must be taught about the nature and degree of the hurricane threat, and stimulated to think about ways to meet it.

Among items in Dr. Frank's indoctrination:

- An estimated 100 hurricane "seedlings" form in the Atlantic, Caribbean, and Gulf of Mexico each year. About 10 of these grow to named tropical storms, with winds of 39 to 73 mph, and hurricanes, with winds of 74 mph or more.
- The average annual number of named storms affecting the U.S. coastline is two, although the total varies considerably from one year to the next.
- Hurricanes come in cycles for different portions of the coast, but forecasters do not know why. In the 1940's Florida was hardest hit; in the '50's the Eastern Seaboard was struck repeatedly; in the 1960's and so far into the '70's, the Gulf of Mexico coastline has suffered most.
- Hurricane forecasters cannot predict whether a coming season will produce more or fewer hurricanes than past seasons, nor can they predict the areas that will be most affected.
- Hurricanes are extremely rare on the U.S. West Coast, although they are a recurring threat to Hawaii, Guam, and other U.S. Territories in the Pacific.
- The average annual death toll in the U.S. from hurricanes and lesser tropical cyclones since the turn of the century was 191. This includes the 6,000 deaths at Galveston in 1900. In the period after Galveston, the average was 114, and here, too, the record varied widely, from no deaths at all, to more than 2,000 in 1928. Property damage was similarly variable, from insignificant damage in some years to 3 billion dollars' worth in 1972, when dying tropical storm Agnes caused record-breaking floods in northeastern U.S.
- A hurricane's damaging winds may extend 25 to 100 mi or more on either side of the eye, a fact sometimes overlooked by people who assume the location for the exact center of the storm is the only place for concern, even though hurricane advisories state otherwise.
- An estimated 9 out of 10 hurricane deaths are drownings in storm surges, with the balance being electrocutions by downed powerlines, lethal blows from wind-propelled missiles, and other miscellaneous causes. Some occur in hurricane-spawned tornadoes.
- Hurricane forecasters strive to provide at least 12 daylight hr of warning time for evacuation. The coastal strips warned average about 300 mi in length, but forecasters are trying to narrow this to minimize overwarning and subsequent loss of confidence in forecast accuracy.

This year the hurricane detection and surveillance network will include the new GOES-1 satellite launched last October 16, and now poised in a seemingly stationary, earth-synchronous orbit, 22,250 mi (35,600 km) high over equatorial Brazil. It will be used to detect hurricanes forming in the Atlantic, Caribbean, and Gulf of Mexico. The SMS-2 earth-synchron-

ous satellite, poised in equatorial orbit over the Pacific, will look for hurricanes and typhoons there. These Geostationary Operational Environmental Satellites are operated by NOAA's National Environmental Satellite Service. Both provide photos of almost the entire disk of the globe every 30 min, taking pictures by visible light by day and by infrared radiation by night. In addition, NOAA's and the Defense Department's polar-orbiting satellites provide photos of a given location twice a day from much lower altitudes.

Aircraft reconnaissance this year will be provided by 10 WC-130 Hercules planes operating from Keesler Air Force Base, near Biloxi, Miss. Seventy percent of the missions will be flown by Air Force reservists, the remaining 30 percent by active-duty crews. A picket line of coastal radars will be on duty as usual to pick up hurricanes when they approach within 250 mi (400 km) of the coast.

In the forecasting process, an experimental numerical model developed specifically for hurricanes will be tested routinely on 1976 hurricanes, using NOAA's giant computers. When a hurricane is within striking distance, a computerized prediction of the height of the storm surge will be called into play, using numerical models developed by the NWS Techniques Development Laboratory.

Finally, after the height of the storm surge has been forecast, local public safety officials in many communities will be able to draw on storm-evacuation maps prepared by NOAA's National Ocean Survey, to advise residents and vacationers of the best routes to move inland or to high ground.

Weather Service officials advise anyone who plans to be in a hurricane-prone area to study the safety rules that follow. A few moments now may save your life later.

HURRICANE SAFETY RULES

A hurricane watch means a hurricane may threaten an area within 24 hr.

A hurricane warning means a hurricane is expected to strike an area within 24 hr.

Enter each hurricane season prepared. Each spring, recheck your supply of boards, tools, batteries, nonperishable foods, and other equipment you will need if a hurricane strikes your town.

When your area is covered by a hurricane watch, continue normal activities, but stay tuned to radio or television for National Weather Service advisories. Ignore rumors.

When your area receives a hurricane warning:

- Continuously monitor the storm's position through Weather Service advisories.
- Check battery-powered equipment. A portable radio may become your only link with the outside world. Emergency cooking facilities and flashlights will be essential if utilities are interrupted.
- Have your car fully fueled.
- If you own a boat, secure it before the storm arrives or move it to a safe area. When the boat is moored, leave it. Do not return to it once the wind and waves are up.
- Board up windows or protect them with storm shutters or tape.
- Secure outdoor objects that might be blown or damaged, or bring them inside.
- Store drinking water--your town's water supply may be contaminated or diminished by hurricane floods.
- Leave low-lying areas when advised to do so. If you live in a mobile home, leave it for more substantial shelter. Mobile homes are extremely vulnerable to high winds.
- If your home is sturdy and at a safe elevation, remain indoors during the hurricane.
- Because hurricanes often cause severe flooding as they move inland, stay away from the banks of rivers and streams.
- Tornadoes are often spawned by hurricanes and are among the storms' lethal effects. When a hurricane approaches, listen to radio and TV for tornado warnings, as well as hurricane advisories.

FRANCE, UNITED STATES ANNOUNCE JOINT OCEANS PROGRAM

New programs to develop methods of protecting the ocean and its resources, and to understand its processes, have been announced jointly by the United States and France.

Dr. Robert M. White, Administrator of the National Oceanic and Atmospheric Administration, for the United States, and M. Yves LaPrairie, President and Director-General of France's National Center for the Exploitation of the Oceans, outlined the plans. The announcement on May 12 concluded a 3-day meeting of the U.S.-French Cooperative Program in Oceanography, held in New Orleans. The collaboration has been underway since 1970.

The two leaders said that nation-to-nation cooperation in ocean affairs, always important, has become more vital than ever as world interest in protecting the oceans increases and as needs for ocean resources become more acute. Ocean problems are of increasing public concern. The past year has brought greatly intensified interest in the oceans. It is fortunate that the U.S.-French program is in being and producing constructive action.

New areas in which the United States and France will cooperate and areas being examined for future cooperation are:

- The exchange of plans and proposals for undersea scientific studies to determine where further cooperative efforts could be undertaken.
- A joint U.S.-French man-in-the-sea experiment, in cooperation with West German scientists, will use the German underwater laboratory Helgoland this summer in the Baltic Sea. Its purpose will be to investigate new instrumentation techniques, ocean processes, and marine organisms on the sea floor.
- Exchange of information of the effects--beneficial as well as harmful--of thermal effluents emitted from major water-sited facilities.
- To acquaint the French with the controlled ecosystem pollution experiment (CEPEX), in which 10- by 30-m "balloons" are being employed under the sea and to help determine the growth and development of natural populations of marine organisms and to study the impact of pollutants upon them.

Other areas in which the two nations are cooperating are coastal processes, marine pollution, man in the sea, manganese nodules, instrumentation, buoy technology and air-sea interaction, and aquaculture.

TRANSPORTATION ACCIDENTS, 1975

The transportation death toll in the United States continued to decline in 1975, according to preliminary statistics released in May by the National Transportation Safety Board.

There were 49,502 fatalities in all transport modes--a reduction of 2 percent from the 50,541 total in 1974. The difference of 1,039 fatalities was caused primarily by 600 fewer highway and grade crossing deaths and 343 fewer fatalities in airline crashes. The Board was encouraged that the upturn in highway deaths, which many had feared would follow the dramatic 18 percent decrease in 1974, failed to materialize. A measure of the task in transportation safety is the fact that 1,039 fewer deaths reduced the transportation toll by only 2 percent.

Airlines registered a 73 percent fatality reduction in 1975, from 467 to 124. Pipeline deaths were down 12 percent, from 34 to 30. All other modes showed increases or decreases of less than 5 percent.

The Safety Board's 1975 statistics were issued in the form of its annual pie chart of transportation fatalities (fig.). The estimated 1975 fatality totals by mode, with comparative 1974 figures in parenthesis are: Highway--44,690 (44,950); rail-highway grade crossings--910 (1,250); railroad--564 (582); marine--380 (379) commercial and 1,480 (1,475) recreational; aviation--124 (467) air carrier and 1,324 (1,290) general aviation; and pipeline--30 (34).

TRANSPORTATION ACCIDENTS *
49,502 FATALITIES
IN 1975

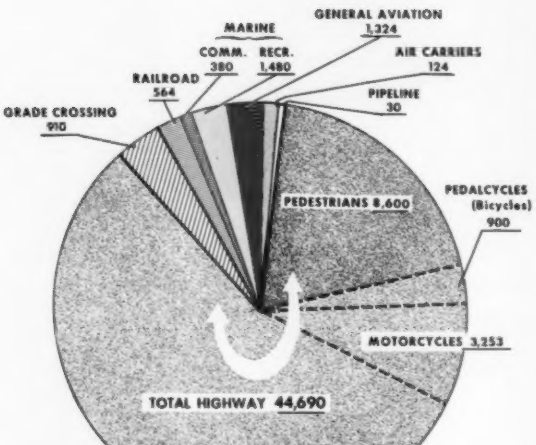


Figure 33.--National Transportation Safety Board accident statistics, 1975.

NOAA's 1975 HURRICANE RESEARCH YIELDS NEW INSIGHTS; PRELUDE TO "STORMFURY"

Preliminary results obtained by NOAA scientists probing Atlantic hurricanes during 1975 confirm that they have the developing, but still immature, cloud towers in the right places to make seeding of them feasible. They also found that winds from the surface to altitude were about what scientists had estimated, and that the ocean "remembers" the passage of a hurricane far longer than does the atmosphere.

Further, the studies demonstrated that more efficient flight patterns, redesigned to keep aircraft in rainbands just outside the region of greatest winds for extended periods of time, could be flown safely through hurricanes.

Although no hurricane seeding was carried out last year (the last hurricane seeded by NOAA was Ginger in 1971), 1975 results reinforced the seeding strategy now evolving for Project Stormfury. That experiment, expected to resume 2 yr from now, will explore whether hurricanes can be modified by seeding with beneficial results. (Project Stormfury is described in the article "Project Stormfury" in the September 1975 issue of the Mariners Weather Log.)

Scientists from NOAA's National Hurricane and Experimental Meteorology Laboratory flew a total of seven missions into three Atlantic hurricanes last year--hurricanes Caroline, Eloise, and Gladys.

A lot of assumptions about the internal dynamics of hurricanes have always had to be made. In a project like Stormfury, it is not enough to seed a storm and then see if its winds decrease. Changes in the storm at several scales of time and space have to be identified. Last year was the first year the laboratory had the technical capability to take the combined cloud physics, air-sea interaction, and turbulence measurements needed in hurricanes.

One major question about hurricane modification has been whether the storms contain clouds in the proper location with the dynamic ingredients which make them seedable. The dynamic seeding technique proposed for Stormfury is based on the premise that supercooled water (water cooled below the freezing point but still in liquid form) in the cloud can be induced to freeze by seeding it with a crystalline material like silver iodide. As the water freezes, it releases heat energy into the cloud, causing the cloud to grow.

In Stormfury this technique would be used to restructure the hurricane. Theoretically, seeding clouds outside the eyewall--the region of maximum winds and vertical development in the storm--would cause them to grow at the expense of the eyewall clouds. This cloud growth would effectively transfer the hurricane's center of action to a new, outer eyewall, spreading an intense storm into a moderate one.

Some hurricane data show large quantities of ice in the middle levels of the storm outside the eyewall, raising the possibility that too little supercooled water was in those clouds to support seeding. In the Caroline and Eloise flights, large areas of flat, stratiform clouds with lots of ice in them were found, which is not good from a seeding standpoint. But a lot of supercooled water mixed in with the ice was also found.

Subsequent analysis of the data identified individual cloud towers imbedded in the stratiform layer that looked like the potential seeding targets believed to be there, but which had not been fully described by previous hurricane research.

Hurricane Eloise, possibly the best measured (fig.

Figure 34.--En route to Atlantic hurricane Gladys, NOAA scientist Robert Sheets uses NOAA satellite photograph of the storm to plot a turbulent day's work.

34) hurricane in history, yielded the first comprehensive look at a storm's vertical wind profile and its impact on the sea. During those flights, the researchers dropped airborne expendable bathythermographs across and in the wake of the hurricane. These measure changes in water temperature (and density) with depth. At the same time sensors aboard a NOAA ocean data buoy in the path of Eloise were switched to a high-rate mode. The result was a profile of the storm from an ocean depth of nearly 2,000 ft (600 m) to an altitude of 25,000 ft (7,600 m).

One question always has been, if you change the wind at the 5,000-ft level, what happens at the surface? The Eloise data linked the aircraft measurements to winds down at the buoy. It turns out that the surface winds are what had been inferred from less direct observations.

Another major finding from Eloise and Gladys was that the passage of a hurricane caused deep upwelling and mixing in the ocean and that these effects last for many days after the storm has passed.

Eloise also taught the scientists something about wind forecasting and the peculiar forms hurricanes can take. On September 16, the NOAA scientists flew into Eloise when the storm, still in its formative stage, seemed to weaken as it drifted along the northern coast of Puerto Rico. It looked like a huge, circular convective system--a cross between a hurricane and a series of huge thunderstorms.

Normal pressure-wind relationships indicated winds of about 40 kn, but sustained winds of 60 to 65 kn were measured over a huge area on the east and northeast sides of the storm. Without a research airplane with sophisticated instrumentation, the observations might have been disregarded as equipment malfunction. What this means is that conventional techniques of estimating windspeeds from satellite photos and aircraft-measured pressures were off by some 50 percent. The pressure-wind relationship is still the best single tool to estimate hurricane strength, but the kind of structure seen in Eloise, when the storm was in one of the weaker stages of hurricane development, will have to be taken into account.

The 1975 missions also provided the first tests of the redesigned flight paths planned for Project Stormfury. In the old Stormfury design, the seeding aircraft--usually jet fighters without environmental instrumentation--entered one side of the hurricane and made a quick, radial pass through the storm and out the far side. The new design puts a research aircraft and its instrumentation into the area to be seeded and keeps it there for repeated seedings and cloud physics measurements of seeding-related changes in the storm.

The pattern was designed with an eye to having escape routes. There was concern about getting caught in the maximum wind bands and having heavy icing at the same time. Consequently, the experiment was designed so that each turn offered a chance to turn away if required.

LARGE ARCTIC EXPEDITION SETS OUT FROM LENINGRAD

More than 1,000 scientists set out from Leningrad on April 5 in what the organizers say is the largest expedition in the history of Arctic exploration.

Planes, satellites, and rockets will probe the atmosphere above the Earth's polar cap while 10 ships will carry specialists to land and drifting ice floes from Greenland to the Bering Strait.

The scientists will compile a "temperature image" which will help to forecast the weather in the Northern Hemisphere. Measurements will be made simultaneously on land, in the atmosphere, in the ocean, and on drifting ice.

The expedition is the Soviet contribution to an international study of world atmospheric processes being carried out under the aegis of the Geneva-based U.N. World Meteorological Organization (WMO).

During the experiments the ships will be plying between the shores of Iceland, Greenland, and the northern tip of Spitsbergen, and also off the northeastern tip of the Soviet Union and Alaska.

Groups of scientists will land on drifting ice in parts of the Arctic Ocean, and high-altitude air probes using meteorological rockets will be carried out from land polar stations and from ships.

The expedition's flagship, the PROFESSOR VIZE, will visit Reykjavik, Aberdeen, Edinburgh, and Rotterdam.

NOAA SCIENTISTS: WEATHER IS PREDICTABLE, BUT THERE ARE LIMITS

One thing about the Earth's atmosphere which scientists are beginning to understand is that probably they will never understand it all. While there is

much which still can be learned, and a real possibility for better weather forecasts of greater duration, some aspects of atmospheric behavior, it seems, simply cannot be predicted.

Researchers at a NOAA laboratory devoted to understanding and predicting weather and climate are beginning to define the inherent limits to prediction. The scientists, at NOAA's Geophysical Fluid Dynamics Laboratory in Princeton, N.J., are doing this by using one of the world's most powerful computers to apply numerical models to simulate the behavior of the atmosphere and oceans. Groups within the laboratory work on different parts of the atmospheric puzzle, from individual clouds to the circulation of entire planets.

The director of the laboratory feels that certain aspects of atmospheric behavior cannot be predicted. The major weather-yielding disturbances in the middle latitudes, called extratropical cyclones, are an example. They result from the fact that the Equator receives more heat from the Sun than do the Poles. The temperature gradient between the Equator and the Poles builds up to a point where the symmetric west-east motions of the atmosphere become unstable. So a wavelike motion develops in the atmosphere to transport heat towards the Pole, and cool air towards the Equator, until the temperature structure is stable again. These wavelike disturbances are identified with the extratropical cyclones. How an existing wave disturbance will develop and where it will be several days later can be predicted, but the location of second- or third-generation disturbances sometime in the future is less predictable.

Many phenomena are predictable, however, up to a point. The laboratory's experimental prediction team sees the inherent limit for deterministic predictions--statements that under observed conditions a certain place will receive "X" amount of rain on a given day--as about 2 or 3 wk, although this view is by no means universal. This predictability limit is due partly to instability processes in the atmosphere. If you are trying to predict the location of a cyclone or anticyclone, these instability processes magnify any initial uncertainty in the data, so that your skill in predicting the evolution of the disturbance gradually diminishes, the farther ahead you look, and becomes zero after about 2 or 3 wk.

Predictability depends in part upon the time scale of the process--how long it takes to develop, run its course, and dissipate. A process like a cyclone system, which changes slowly, is more predictable than an individual cumulonimbus cloud.

The irregularities of the Earth's surface also help determine predictability. If the Earth were uniform--all flat continent or all ocean--the wavelike disturbances that equalize heat distribution would have no preferred longitude at which they would form, only a preferred time. The role of the mountains, oceans, and continents is to put a bias in the longitudinal position where these disturbances form. They tend to form in some places, like in the Gulf of Mexico, more readily than others.

This also means that some places on the planet have more predictable weather than others. The Southern Hemisphere has much more ocean and narrower continental irregularities (and therefore is more uniform) than does the Northern Hemisphere, and it is suspected that there is a little less predictability in the Southern Hemisphere than in the Northern Hemisphere.

Though meteorologists may not be able to predict a particular event months in advance, a statistical approach can provide probabilities, and if the procedures and the data are precise enough, that can amount to prediction.

Certain statistical properties may be predictable, even if the details are not. For example, it may not be possible to tell where an individual extratropical disturbance will be, but it might be possible to tell where the storm tracks are which mark the most likely place where the disturbance may pass.

One way to get a hold in the slippery atmosphere might be indirectly, through its response to the ocean. The atmosphere is very forgetful of its past; it changes very fast, but the state of the ocean changes slowly. With something which changes slowly, it may be possible to predict a little longer. It is hoped that, with a model in which the ocean and atmosphere are coupled, one may predict the slow changes of the ocean and thereby the statistical state of the atmosphere sitting on top of that future oceanic state. So, there is hope that we may be able to make long-range forecasts of some kind.

All this is highly speculative. Right now, the Princeton scientists are working to discover to what extent a sea surface temperature anomaly affects the atmosphere, if at all. So far, the natural fluctuations of the atmosphere make it difficult to distinguish the effects of sea surface temperature changes in middle latitudes, but there is a clearer relationship in the tropics.

Another potential weather modifier the group is studying is snow cover--whether, for example, snow cover over Wisconsin in early spring affects the temperatures of late spring.

Whatever the theoretical limits of prediction may turn out to be, there are still many practical limitations to be overcome. Models are not perfect, the data are not perfect, and one has to make certain mathematical compromises because the computing machines are not infinitely fast. An experiment with the laboratory's most complicated model may devour as much as 500 hr of computer time.

This gives a practical limit of predictability which is somewhat short of the theoretical limit, and it is this gap between the two that needs to be closed by getting better observing systems, faster computers, and models which look more like the real atmosphere.

JAG DEV ENCOUNTERS NORTH PACIFIC APRIL SNOW STORM

The following account of a snow storm was extracted from the April 15, 1976, weather log of the Indian motor vessel JAG DEV, a 13,326-ton cargo vessel. The JAG DEV is an Indian supplemental observing vessel. She was bound from Wakayama, Japan, to Seattle. Mr. Donald Olson, the Port Meterological Officer in Seattle, copied and forwarded this account to the Mariners Weather Log.

15/4/76 - Motor vessel JAG DEV. Captain R.K. Narain, Wakayama to Seattle. Observers: P.S. Dhariwal, Chief Officer; M.R. Fraser, Second Offi-

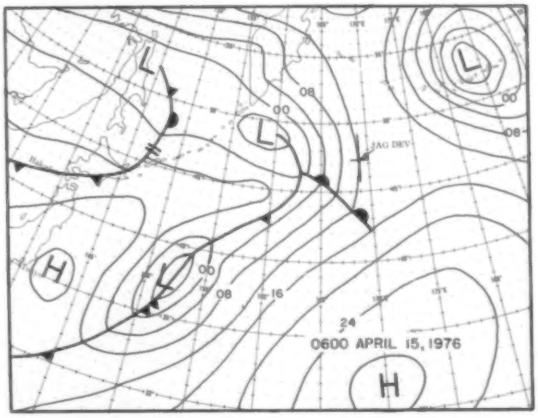


Figure 35.--Synoptic conditions at 0600 April 15, 1976, in which JAG DEV encountered snow storm.

cer; M. M. Singh and P. John, Cadets; and the full ships' company.

Course 066° (T) Great Circle track, speed 13.25 kn, light condition, full ballast. SMT = GMT + 1100 hr.

0000 - 0400--Wind NE force 2, barometer 1016 mb, temperature 1°C, slight sea and low swell, overcast and hazy.
0545--Light snow observed.
0600--Visibility decreases to approximately 1 mi, barometer falling, wind veering and intensifying, snowfall increasing.
0800--Wind SE force 6, barometer 1013.5 mb, temperature 0.5°C, low swell, sky obscured, visibility approximately 0.5 mi, heavy snow.
1200--Wind SE force 6, barometer 1009.3 mb, temperature 0°C, moderate sea, low swell, very heavy snowfall, visibility less than 0.25 mi, alter course to 077 (T). D.R. noon position (15/0100 GMT) 47°02'N, 166°55'E (fig. 35).
1600--Wind SSE force 6/7, barometer 1003 mb, temperature 1°C, moderate rough sea with moderate swell, very heavy snowfall.
1842--Wind ESE force 8, barometer 1001 mb, temperature 1°C, rough sea, moderate/heavy swell, shipping spray on deck, visibility improved to 4 mi, snowfall ceased.
2000--Wind ESE force 7/8, barometer 998.5 mb, temperature 1°C, rough sea, moderate/heavy swell, overcast with intermittent light snow, visibility 4 to 5 mi, shipping light spray.
2400--Wind ESE force 7, barometer 999 mb, temperature 2.5°C, rough sea, heavy swell, rolling and pitching moderately, shipping seas on foredeck, overcast, visibility 2 to 4 mi.

The vessel experienced a blizzard at sea for about 13 hr. After 2000 the barometer rose very slowly for the next 24 hr. This vessel's normal run is India to Japan to the U.S. West Coast and return. It is a supplementary ship of the Indian Voluntary Observing Fleet. This has been the first time we have experienced such weather in the North Pacific in the month of April. During the following 4 days, the wind was westerly with passing showers of snow 10 to 15 times per day. On the 16th, the temperature rose to 5°C at 1200 with the barometer 1000.5 mb. During the next 3 days the average daily high temperature was 3°C, and the low temperature was 1°C.

Editor's Note: The weather the JAG DEV encountered resulted from a relatively small LOW that moved out of the Sea of Okhotsk. At 0600 GMT on the 15th, the 964-mb center was near 49°N, 159°E. At that time the JAG DEV was near 47.3°N, 168.6°E, and the SANTA CATALINA MARU was approximately 100 mi to the southwest and reporting intermittent heavy snow. There was a 990-mb LOW northeast of the JAG DEV's position and a 994-mb frontal wave to the southwest. The 992-mb LOW, the frontal wave, and two other low centers were all part of one large circulation.

The 992-mb LOW was moving northeastward at about 20 kn. It is estimated that a rapidly weakening front moved eastward past the JAG DEV at about 2300 GMT. The frontal system with the 992-mb LOW dissipated as the frontal wave to the south raced eastward.

LETTERS TO THE EDITOR

SEVERE MAINE COAST STORM, FEBRUARY 2

Quartermaster Roderick J. O'Connor, U.S. Coast Guard Group, Southwest Harbor, Maine, sent the following letter and two pictures concerning the severe storm (Monster of the Month) that swept the coast of Maine on February 2.

"Enclosed are two pictures which I took of the damage caused by the storm of February 2 along the coast of Maine (figs. 36 and 37).

"The grounded freighter is the Japanese motor vessel MUSASHINO MARU, which was blown aground at Searsport, Maine, during the gale. The ship was blown from its anchored position in Penobscot Bay by the gale-force winds shortly after 0600 local time (1100 GMT).

"The second picture shows the remains of a hardware store and piers which were blown into the bay at Eastport, Maine, during the same storm. The wreckage took over 3 days to clean up and blocked boat traffic in and out of the Eastport town dock.

"I hope that these photos may be of interest to the Mariners Weather Log and that they may be of sufficient quality for publication.

"Being stationed at Coast Guard Group, Southwest Harbor, Maine, I had the chance to see firsthand the damage which occurred from the extremely severe storm.

"The anemometer indicator located at Bear Island Light Station at Northwest Harbor, Maine, just 5 mi east of here, recorded wind gusts of over 100 kn before being blown down, and gusts here at Base Southwest Harbor were well over 65 kn. Also a low barometer of 28.59 was recorded on an official, NWS-calibrated barometer.

"Hoping these may be of use to you, and always enjoying the magazine."

Figure 36.--The Japanese motor vessel MUSASHINO MARU appears moored to the trees at Moose Point, Maine. Photo courtesy of Q.M.2 R.J. O'Connor, USCG.

Figure 37.--The town pier at Eastport, Maine, where buildings and piers were destroyed by the storm. Photo courtesy of Q.M.2 R.J. O'Connor, USCG.

MARINE WEATHER REVIEW

The SMOOTH LOG (complete with cyclone tracks [figs. 41-44], climatological data from U.S. Ocean Station and Buoys [tables 9 and 10], and gale and wave tables 11 and 12), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

Smooth Log, North Atlantic Weather

January and February 1976

SMOOTH LOG, JANUARY 1976--The over-water movement of the low-pressure centers closely approximated climatology. An exception to this was along the U. S. Southeast Coast, as most of the storm centers moved offshore over the middle Atlantic Coast rather than farther south as is usual. The storms formed farther north than usual with the Great Lakes region supplying more than normal. The storms over the Great Lakes moved easterly rather than the usual northeasterly. The average track would be from central Illinois to New Jersey, then gradually arc to a point about 100 mi off Cape Race, and then to Iceland and the Norwegian Sea.

There were many differences in the mean monthly pressure pattern. Normally, the Icelandic Low consists of two centers with the primary center east of Kap Farvel. This month, the lowest center was over the Norwegian Sea where the secondary center is normally located. Both pressures were lower than climatology. The 995-mb center was near 70°N, 10°E, and the 997-mb center was near 62°N, 30°W. The Azores High at 1029 mb was at 42°N, 20°W, about 10° of latitude north of its 1020-mb climatic position. A secondary 1025-mb center was near 32°N, 50°W.

Of course, the anomaly centers closely matched the pressure centers. A negative 10 mb was near 70°N, 10°E, a negative 5 mb near 65°N, 25°W, and 60°N, 80°W. A major part of the North Atlantic from 20° to 60°N was covered by positive anomaly values as was the United States.

The upper-air pattern was normally located. The significant difference was that the troughs and ridges were more intense. This was accentuated by a high center off Spain near 40°N, 20°W. As with the surface, the major part of the open ocean was dominated by positive anomaly values.

Extratropical Cyclones--Monster of the Month--This was the worst storm to strike northwestern Europe in 29 yr according to a British spokesman. On New Year's Day, a front stretched east-west along approximately 50°N. A frontal wave formed and moved eastward across the United Kingdom and the North Sea late on the 1st. At 1200 on the 1st, another LOW formed just south of Iceland, and another wave was moving northeastward out of midocean.

At 1200 on Friday the 2d, there were two LOWs, a 990 mb near 62°N, 12°W, and a 985 mb near 55°N, 10°W. The MANCHESTER CHALLENGE (52°N, 15°W) and the SEA-LAND RESOURCE (50°N, 20°W) were both near the front with 45-kn gales. Their highest seas were 18 ft and swells 25 ft. Gales were reported on the southwest coast of Ireland.

At 0000 on the 3d, the two LOWs had combined near 59°N, 05°E, at 972 mb. Strong winds with gusts to 90 kn were blowing across England and all the countries bordering the North Sea. The high winds wracked havoc by blowing down trees, roofs, buildings, and power lines. Fifty-five people were killed, including 26 in Britain and 12 in West Germany. The high waves and tide damage were even more spectacular. At Liverpool, a $2.5 million prefabricated concrete ferry landing stage was washed away. Waves 60-ft high crashed onto Britain's East Coast. Flooding caused 20,000 Danes in southwestern Jutland to evacuate their homes. Winds up to 70 kn were reported as far south as Vienna.

Winds, waves, and tides were responsible for the grounding or sinking of many ships and the flooding of many harbors. At least 20 ships in or near British waters were in trouble. The

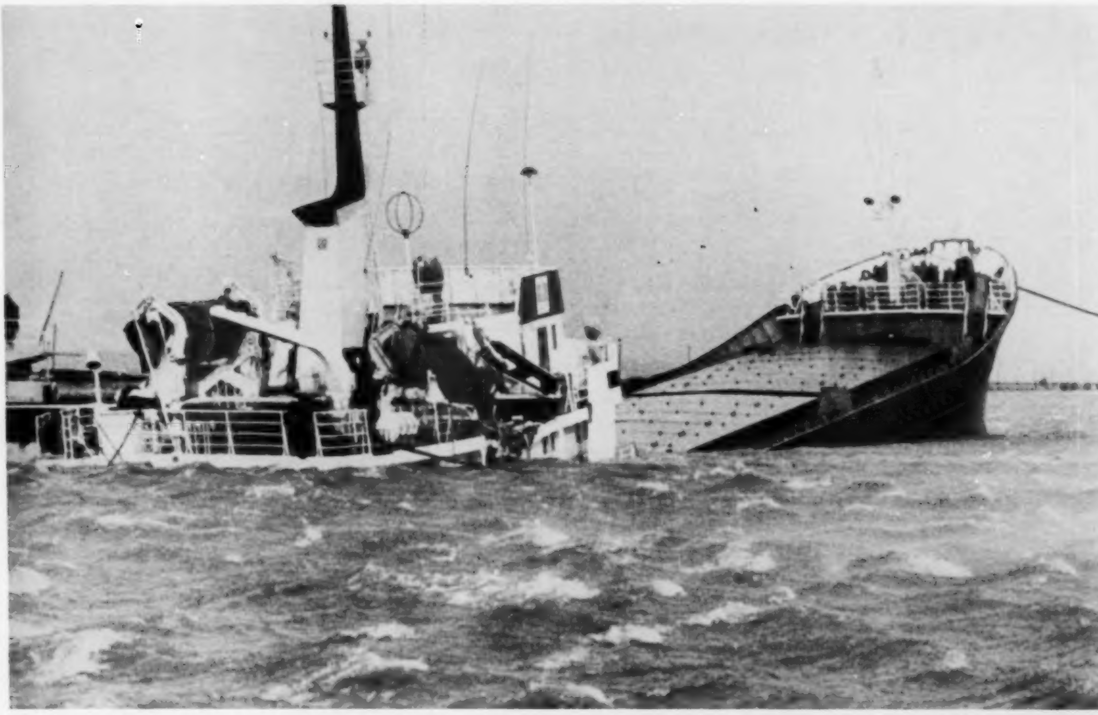


Figure 38.--The Singapore freighter GABBRO rests on the bottom of the Kiel Canal after a collision in heavy fog. Wide World Photo.

1,373-ton Cypriot NORTH STREAM was torn from its moorings in the Elbe River. The 16 crew members were rescued by helicopter. A small West German ship was blown aground, and two others collided in the Kiel Canal. The 20,000-ton tanker MYRNA at an English port was ripped from her moorings and was refloated after grounding. The East German coastal freighter CAPELLA sank in the North Sea with 11 crew members missing. Seven Norwegian fishermen were missing after the FRITZ ERICK sank off Senja Island. The Singapore-registered GABBRO sank in the Kiel Canal (fig. 38). The 2,485-ton KING ORRY broke moorings and ran aground in the Lune River.

By 1200 on the 3d, the 972-mb LOW had moved into the southern Baltic Sea, but it was still lashing the area with powerful winds. Inland stations were recording prevailing 35-kn winds. By 0000 on the 4th, the LOW was over Poland and later in the day raced into Russia.

This storm moved out of the Gulf of Mexico. On the 1st, it moved off the Atlantic Coast north of Norfolk, Va. The CARBIDE TEXAS CITY was hammered by 60-kn winds and 20-ft seas at 0600 at 34.5°N, 76.2°W. At 0000 on the 2d, the DAINANOH MARU was at 32.7°N, 69.5°W, with 26-ft swells. On the 3d, the 978-mb LOW was near 49°N, 47°W. The PALEKH, at 44.1°N, 55.2°W, was sailing into 50-kn winds. At 1200, the THUREDRECHT was battered by 55-kn winds and 25-ft waves. The LOW was moving northward very slowly. At 1200 on the 4th, the C.P. DISCOVERER was about 200 mi southeast of the center with 50-kn westerly winds and 20-ft waves.

On the 5th, the center was approaching Kap Farvel. Far to the south, but still in the circulation of the enormous LOW, the LASH ESPANA (38.3°N, 49.2°W) pounded into 50-kn winds and 30-ft waves. On the 6th and 7th, OWS Charlie and Lima has 26- and 23-ft waves, respectively. On the 8th, the LOW passed south of Iceland and into the Norwegian Sea.

A high-pressure area off the U. S. East Coast broke down rapidly, on the 12th, and a LOW developed south of Cape Cod. At 1200, the CORALSTONE was near the cold front at 38°N, 64°W, plowing into 45-kn gales and 20-ft seas on her port bow. The 994-mb LOW was near 44°N, 52°W, at 1200 on the 13th, and the VGBZ was at 43.4°N, 60.1°W, with snow showers and 45-kn winds. The MORILLO was near 39°N, 60°W, with 40-kn winds, 16-ft seas, and 33-ft swells. Not to be outdone, the AMERICAN LEADER was headed home into 45-kn winds and 36-ft seas. At 0000 on the 14th, the M.P. GRACE was near 40.9°N, 41.4°W, and also had 55-kn winds. The seas were 12 ft and the swells 15 ft.

Multiple centers had now commenced to develop with the northern ones racing off toward the northeast and dissipating. On the 14th, several ships reported gales up to 45 kn and seas to 23 ft. Among these were the AMERICAN LEGACY and the ATLANTIC CROWN.

On the 15th, the LOW was rapidly weakening as it was squeezed by a HIGH near Lands End and another

LOW over Labrador.

This storm was assembled in the Oklahoma storm factory on the 13th. It deepened and intensified very rapidly as it raced northeastward to near 46°N, 72°W, at 1200 on the 14th. At that time it was 983 mb and had been moving with a speed of approximately 45 kn. Ships were already finding gales off the mid-Atlantic Coast. Sixty-knot gusts were reported on Cape Cod at Chatham. At 0000 on the 15th, the LOW was over Anticosti Island. The VGBZ, still near 43°N, 60°W, was tossed by 60-kn southwesterly winds and 20-ft waves. The LASH ESPANA (38°N, 59°W) was farther south with 40-kn gales but 23-ft waves. At 1200, the CRYOS was in the Strait of Belle Isle with 50-kn winds, and in this confined area had 16-ft waves. The LOW reached its minimum pressure of 970 mb at 0000 on the 16th. It moved north into the Labrador Sea to disappear in the fjords of southwest Greenland.

This was a complex system of LOWs. Originally, a storm system moved across the Great Lakes on the 16th. As the leading edge of the circulation moved over the water, another LOW developed south of Nantucket Island, moved northeastward, and became the major circulation. To the south, along the front, a wave developed over South Carolina, on the 17th. At 1200, the VGBZ reported 55-kn winds south of Sable Island. At 1800, the ESSO LEXINGTON was off Cape Hatteras (34.8°N, 74°W) where she was hit by 75-kn winds during a thunderstorm. The 500-ft former Navy attack cargo transport BETELGEUSE (fig. 39) which was originally the World War II Victory ship COLUMBIA VICTORY was driven ashore by the strong winds. She was being towed to Texas to be scrapped. The tug TAURUS reported winds of over 50 kn.

The South Carolina LOW intensified rapidly over the Gulf Stream and became the major storm. At 0000 on the 18th, the 980-mb storm was near 36°N, 70°W, Ocean Weather Station Hotel measured 45-kn winds and 18-ft seas. There were seven reports of 40-kn winds in various quadrants of the storm. The ships with wave heights included the ELBE EXPRESS (25 ft), GUAYAMA (21 ft), JACKSONVILLE (33 ft), MAYA-

Figure 39. --The BETELGEUSE broke its tow in the storm and beached near Cape Hatteras. Bob Grieser Photo.

GUEZ (13 ft), and ROBERT E. LEE (25 ft).

By 1200 on the 18th, the 986-mb LOW was at 45°N, 61°W. The VGBZ was now measuring 60-kn winds with 23-ft seas as the front neared. Farther south, the SCHAVENBURG was tossed by 60-kn winds and 25-ft waves along the front. Not far away, near 36°N, 64°W, the DUMBAIA was ravaged by winds of only 50 kn, but the swells were reported as 49 ft. East of the front near 40°N, 55°W, the EXPORT LEADER was pounded on the port side by 50-kn winds and 30-ft waves. Back near the center, the ATLANTICA LIVORNO fought 33-ft swells from the south. Another ship in the vicinity of 29°N, 67°W, reported a "violent electric storm plus wind shift from S to WSW at 1015." The ROBERT E. LEE was at 40.4°N, 58.1°W, and logged 48-kn winds, 20-ft seas, and towering 65.5-ft swells. There is a possibility of a decoding error, but considering the other high waves reported, the height could easily be accurate.

The storm was being squeezed by two large HIGHs, and on the 19th, the Nantucket LOW moved up the southwest coast of Greenland while the South Carolina LOW quickly disappeared.

As the LOW mentioned above moved west of Kap Farvel, a 970-mb LOW formed southeast of the Cape. The pressure gradient between the LOW and a 1041-mb HIGH near 44°N, 30°W, was very tight. Ocean Weather Stations Charlie and Lima measured 20-ft waves, and the SKIENSFJORD had 23-ft seas. At 1200 on the 19th, the LOW was 950 mb off Keflavik. The GODAFOSS (59.5°N, 29°W) fought 50-kn winds, and the LINDA DAN (61°N, 21°W) 45 kn. Lima now had 40-kn winds, 20-ft seas, and 23-ft swells.

The wind flow between 50° and 60°N was nearly straight from coast to coast, and although not as strong as the gradient would indicate, it produced high waves as a result of the long fetch. The SKIENSFJORD reported 26-ft seas; Charlie, 23-ft swells; and Lima, 30-ft seas and 36-ft swells, at 0000 on the 20th.

At that time, a new LOW formed off the coast of Norway, and at 1200, another LOW appeared south of the Denmark Strait with the LOW over Iceland disappearing from the analysis. The LINDA DAN still had 25-ft seas, and Lima now measured 50-kn winds, 30-ft seas, and 41-ft swells. Gales lashed the British Isles from Scotland (cover) to the south coast, causing at least four deaths and possibly damage into the millions of pounds. On the 21st, Lima still had 34-ft swells, and her swell reports continued to be over 20 ft until the 24th.

A storm developed off Long Island on the 22d. By 0600, the GULF QUEEN was being battered by 50-kn winds and 33-ft waves. At 1200, the LOW was over Nova Scotia at 975 mb. Gales to 45 kn were reported south of the center and west of the cold front. These included Ocean Weather Station Hotel and the USCGC EVERGREEN. At 0000 on the 23d, five ships radioed 40-kn winds in the area bounded by the coast, 35°N, and 60°W. At 0900 and 1200, OWS Hotel had 50-kn winds, with 31-ft and 25-ft seas, respectively.

As the LOW moved northward up the coast, a HIGH was centered over central Canada, and the northerly flow between them fed extremely cold air from the Arctic into the eastern United States. The Chesapeake Bay froze, with ice up to 10 in thick in the northern part. Coast Guard cutters broke through the ice to lead a convoy out of Baltimore on the 23d.

During this same time, the Azores High was moving northward and building. By 0000 on the 24th, the LOW had moved northwestward to near Ungava Bay, and one cell of the HIGH was centered between Kap Farvel and Iceland at 1047 mb. Two small LOWs had developed near Newfoundland. Four ships were battered by 40-kn gales south of the southern LOW. One was the MARIE LEONHARDT with 26-ft waves. Farther north along the front, the NEW ENGLAND TRAPPER (48°N, 45°W) had 50-kn winds. At 1200, the HIGH was 1050 mb near 60°N, 23°W.

On the 25th, the LOW was over Baffin Island and the HIGH was retreating southward and decreasing in pressure.

This was a multinational, intercontinental storm. It was first analyzed, late on the 25th, over the lower Ohio River, and moved northeastward over Lake Huron to northern Quebec on the 27th. It had remained a rather weak storm until moving over the Labrador Sea. By 1200 on the 28th, its pressure had plunged to 968 mb near 58°N, 31°W, but only weak gales had been reported.

Twelve hours later, the situation changed rapidly. The LOW now at 954 mb was near 56°N, 24°W. At this time, Ocean Weather Stations Charlie and Lima both measured 50-kn winds and 26-ft and 21-ft waves, respectively. The ERNST KRENKEL, near 49°N, 28°W, also fought 50-kn winds and 30-ft seas. At 0600 on the 29th, the SEA-LAND VENTURE (46.8°N, 19.4°W) measured 56-kn winds and 15-ft seas.

The storm was really pounding ships, on the 1200 chart of the 29th, with high waves. The AMERICAN LEGACY had 55-kn winds and 36-ft swells. Ocean Weather Station Romeo survived 46-ft seas. The POLYARNYY KRUG (45°N, 26°W) fought 55-kn winds and 36-ft swells, the GEEST-TIDE 60-kn winds and 23-ft swells, and several other ships battled 20- to 25-ft waves, including OWS Lima. On the 30th, the high winds and waves were continuing. Ocean Weather Station Romeo was still battling 50-kn winds, and now the seas were 49 ft. The CAROLA REITH, at 46.4°N, 26.1°W, also contended with 50-kn winds, but the swells were only 33 ft. The ERNST KRENKEL now reported 28-ft swells.

The LOW was moving southeastward at 974 mb at 1200 on the 30th. Ocean Weather Station Romeo measured 40-kn winds and 46-ft seas. The GANYMEDES (44°N, 19°W) had 40-kn winds, 18-ft seas, and 34-ft swells. The FROSTFJORD (41°N, 19°W) had 50-kn winds with no seas reported, and the VALYA KOTIK (44°N, 13°W) reported only 30-kn winds with 30-ft seas. The 28,673-ton motor vessel IVY loaded with iron ore ran aground in heavy weather outside the harbor at Vigo, Spain, on the 30th. On the 31st, the vessel broke in two, and the bow section sank immediately. All crew members abandoned ship and were safely ashore.

On the 31st, the LOW entered the Bay of Biscay slowly filling but still producing high swell waves. The CHIKUZEN MARU and OWS Romeo reported 23-ft and 30-ft waves, respectively. A HIGH was centered over Scandinavia, and the easterly flow between

the LOW and the HIGH brought western Europe its most severe cold wave in 4 yr.

On February 1, the storm was over the Mediterranean Sea and for the next 3 days tracked eastward over that body of water with no significant winds reported.

Casualties--Early in the month, the 1,568-ton Cypriot vessel EVDOKIA K. was holed and beached to prevent sinking after a collision with the 13,392-ton Indian vessel JAG DOOT, in heavy fog, off Canakkale in northwestern Turkey. The 30,510-ton West German bulkcarrier BERNHARD OLDENDORFF went aground in heavy rain at mile 169.5 of the Orinoco River. The Greek FRATERNITY (3,591 tons) broke moorings during a heavy storm and ran aground off Gaza on the 5th.

On the 24th, the 250,000-ton tanker OLYMPIC BRAVERY developed engine trouble and was forced onto the rocks of Ushant Island by heavy seas. The same seas prevented immediate refloating, and she was holed. The newly built vessel was in ballast headed for lay up in Norway.

The Greek-registered CHRONIS IV (946 tons) ran aground near Pylos in a heavy gale on the 27th. The Liberian-registered bulkcarrier IVY (28,646 tons) broke in two and sank near 42.1°N, 08.9°W, on the 30th, after running aground in heavy weather.

SMOOTH LOG, FEBRUARY 1976--The number of low-pressure centers over the shipping lanes was above average. They tended to form farther north than usual off the U.S. East Coast. The mean track would be from the approximate coordinates of 42°N, 60°W, to 47°N, 40°W, to 53°N, 30°W, where the track split, half tracking toward the southeast coast of Greenland and the remainder moving over Iceland into the Norwegian Sea. There were three storms in the vicinity of the Azores Islands and the usual Mediterranean Sea storms. Across the United States and Canada the track was farther south, converging out of the south central plains and northern plains over southern Michigan and then tracking up the St. Lawrence River Valley. Many dissipated, but others continued over Newfoundland into the main storm stream. Two moved north into the Labrador Sea.

The mean monthly sea-level pressure pattern was near normal in outline, but the pressures differed greatly. The Icelandic Low was 987 mb versus the 1003 normal near 62°N, 35°W. The Azores High was 1027 mb versus 1020 mb and located at 30°N, 40°W, 10° longitude west of its normal position. There was an anomalous closed HIGH over western Russia. The pressure over the United States was near normal, but slightly lower over the north central area.

The major negative anomaly surrounded Greenland with several centers. The deepest was 19 mb near the North Pole with a trough paralleling the eastern coast of Greenland to a 17-mb center near 62°N, 35°W, the location of the Icelandic Low. A positive 9-mb center was near 35°N, 40°W, in conjunction with the Azores High. Another large positive 14-mb center was near Kiev (52°N, 30°E).

The upper-air pattern differed mainly with climatology in height. The major circulation at 700 mb was centered over Baffin Island. As with the surface, it was lower than normal. The anomalous HIGH over Russia was reflected at 700 mb resulting in a ridge over Scandinavia rather than a trough. A slight ridging that is normally west of Europe was displaced by cyclonic curvature.

Extratropical Cyclones--On the last day of January there were several isolated pressure centers south of Nova Scotia. By February 1, they had consolidated, and a 986-mb LOW was southeast of St. Johns. At 1200, the LOW was 974 mb near 51°N, 40°W. The CAROLA REITH (47°N, 39°W) and the ATLANTIC CHAMPAGNE (46.6°N, 37.7°W) were both ravaged by 60-kn winds. The REITH was fighting 49-ft seas. A short distance away the CHAMPAGNE contended with only 26-ft waves. Two ships, one being the OSSENDRECHT, had 55-kn winds. There were gales reported in all quadrants.

At 0000 on the 2d, the winds were still roaring south and southwest of the center. The REITH was still reporting 60 kn when the storm overtook the C. P. VOYAGEUR with 60-kn winds and 26-ft waves. At 1200, the LOW was 980 mb near 50°N, 27°W. Three more ships were added to the 60-kn club--the HAHNENTOR, GELA, and SPRUCEBANK. The ATLANTIC CHAMPAGNE (48°N, 36°W) had 65-kn winds with waves decreasing to 38 ft. The GELA (46°N, 24°W) had 65-kn winds and 52-ft waves. Other ships with high waves were the AMERICAN ACE (49 ft), SEA-LAND CONSUMER (33 ft), and SEA-LAND RESOURCE (30 ft).

The storm had turned southeastward by the 3d with the JAMAICA PRODUCER reporting 33-ft swells 300 mi southwest of the center. The SEA-LAND CONSUMER, at 43.3°N, 30.7°W, had 50-kn winds, 23-ft seas, and undescribable 65-ft swells. At 1200 the PRESIDENT MONROE, near 42°N, 26°W, had 45-kn winds, and the swells were a devastating 39 ft. The storm continued its southeastward track, and at 1200 on the 4th, the BOOKER VIKING found the same 45-kn and 39-ft wind and swell area. The Canary Islands measured 45-kn winds. Late on the 4th, the storm turned eastward and went ashore over Cabo de Sao Vicente.

Monster of the Month--This storm preferred the coast lines. It moved eastward along the Gulf Coast on the 1st and reached the East Coast on the 2d. At 0000, the EB15 measured 40-kn winds off South Carolina. It raced up the East Coast deepening explosively. At 0000 on the 2d, it was 986 mb over the Carolinas. By 1200, it was 960 mb near Portland, Maine. About 0600, a 2,995-ton Japanese freighter

Figure 40.--The 362-ft MUSASHINO MARU was refloated with the aid of tugs and an extremely high tide. Wide World Photo.

went aground in high winds at Searsport, Maine. She was finally freed on the 15th (fig. 40). The winds forced a barge aground in Chesapeake Bay, and it sank, on the 1st, spilling thousands of gallons of crude oil.

At sea, ships measured hurricane-force winds. The AMERICAN ACCORD, at 39.8°N, 69.5°W, was mauled by 85-kn winds and 41-ft waves. The ESSO NEW ORLEANS measured 70-kn winds at 1300, at 40.3°N, 69.6°W, with 30-ft seas. Other ships that reported devastating waves were: STAGHOUND (41 ft), SYLVO (33 ft), SAN JUAN (46 ft), and AMERICAN LEGACY (41 ft). Ocean Weather Station Hotel measured 70-kn winds and 28-ft seas.

There was extensive damage along the coast from Cape Hatteras north to Maine. Winds and gusts from 50 to 100 kn occurred along the coasts knocking down trees and powerlines with much flooding helped by heavy rains. Freezing temperatures on the west side of the LOW contributed to the misery. Record or near record low pressures were measured at several locations. Boston recorded their second lowest pressure of 28.48 in (964.4 mb); Caribou, Maine, 28.26 in (957 mb), a record; and an unofficial 27.90 (945 mb) at Wiscasset, Maine. A tanker broke its moorings near Annapolis, Md., and collided with another tanker.

By 1200 on the 3d, the 948-mb LOW had raced to near Hebron, Labrador. The ESSO NEW ORLEANS was still measuring 70-kn winds and 30-ft seas near 41.5°N, 68.8°W. The AMERICAN ACCORD, only a few miles away, near 41.2°N, 65.1°W, was concerned more with the 41-ft waves than the 50-kn winds. Near Newfoundland, the N.B. MCLEAN and CRYOS reported 45-kn gales. On the 4th, ships were still reporting 40-kn winds and 20-ft seas. The LOW moved across the Labrador Sea and died over the Davis Strait.

This storm system formed as a trough and moved off the coast of Nova Scotia on the 5th. By 1200, the MANCHESTER VIGOUR was receiving 45-kn winds ahead of the cold front. At 0000, the 978-mb storm was at 49°N, 39°W. The DART ATLANTIC (46°N, 35°W) and the NINA KUKOVEROVA (45°N, 39°W) found 50-kn winds. The HECTOR (43°N, 43°W) was sailing into 45-kn gales and 25-ft waves.

At 1200 on the 6th, high wind reports were numerous. Ocean Weather Station Charlie had either 55- or 65-kn winds. The DART ATLANTIC was now fighting 65-kn hurricane-force winds and 33-ft waves. The WESER EXPRESS had 60-kn winds, but swells only picked up to 20 ft. The following ships had 40- to 55-kn winds: AMERICAN ACCORD, AMERICAN ALLIANCE, MOSEL EXPRESS, NEW ENGLAND HUNTER, and NORAMAR. The LIGHTNING was tossed by 36-ft swells as was the AMERICAN ACCORD with 41-ft seas.

The storm turned northward on the 7th. The DART ATLANTIC was still battling 50-kn winds and 36-ft swell, near 45°N, 36°W, as she slowly progressed westward. The central pressure was down to 942 mb at 0000 near 57°N, 34°W. By 0000 on the 8th, pressure had risen to 954 mb off the southeast coast of Greenland. The AMERICAN ACCORD was now south of Fastnet Rock with light winds, but the swells were still 33 ft. On the 9th, only a trough remained.

This storm formed over the Dakotas and moved across the Great Lakes on the 15th. At 1200 on the 16th, it was 994 mb over Prince Edward Island. The VGBZ, south of Sable Island, measured 50-kn winds. The storm moved off Newfoundland and was 978 mb, near 51°N, 42°W, at 1200 on the 17th. The WAARDRECHT, near 46°N, 38°W, ahead of the occlusion had 60-kn winds and 33-ft waves on her starboard side. At 0000 on the 18th, the ATLANTIC CROWN had 50-kn winds near 46°N, 40°W. At 1200, Ocean Weather Station Charlie suffered through 50-kn winds and 28-ft seas.

This LOW turned northward late on the 18th and was 956 mb at 0000 on the 19th. The SLETTBAKUR had 60-kn winds south of the Denmark Strait. Ocean Weather Station Charlie was still riding 26-ft waves. At 0000 on the 20th, the LOW was pounding against the coast of Greenland and losing strength rapidly. By 1200, it had combined with the following storm.

A minor trough in the upper air raced across the northern States on the 17th. As the associated surface LOW approached the East Coast, a frontal wave formed ahead of it over the water. Within 12 hr, it was the primary system.

At 0000 on the 18th, the LAURENTIAN FOREST (42°N, 56°W) was only 60 mi north of the apex of the wave with 45-kn gales. The 1200 chart showed only one circulation at 990 mb, as the previously described LOW moved northward. The JOSEPH D. POTTS (37.1°N, 49.3°W) estimated 50-kn winds and had 12-ft seas and 33-ft swells. At 0000 on the 19th, the LOW was 981 mb near 43°N, 34°W. The HECTOR, at 41°N, 39°W, was headed northward into 65-kn northerly winds. No seas were given. The AMERICAN ACCORD was now headed westward with 50-kn winds and 25-ft waves. This LOW moved farther eastward before turning northward like its predecessor. At 1200, the WESERMUNDE reported 50-kn winds and waves to 26 ft in the southwest quadrant, while the ANTON DOHRN contended with 45-kn gales on her starboard bow in the northeast quadrant. At 0000 on the 20th, Ocean Weather Station Lima was 120 mi northeast of the 965-mb center with 50-kn southeasterly winds and 23-ft seas. Gales were blowing on both sides of the cold front which stretched southward to 35°N before curving southwestward.

By 1200 on the 20th, this LOW and the previous LOW had combined at 962 mb near 63°N, 29°W. Only minor gales were recorded. The LOW curved southward along the Greenland Coast to disappear near Kap Farvel.

By the time this LOW reached the coast it was a large storm. It had originated in the lee of the Rocky Mountains. It was pushing against a large 1035-mb HIGH that was centered south of Newfoundland. The SEA-LAND MARKET, near 38.1°N, 61.9°W, struggled with 54-kn winds on the 23d. Ships east of the cold front had 35- to 40-kn winds. The AMERICAN ACCORD, it seemed, could not avoid bad weather. At 1800 they reported 47-kn winds and 33-ft swells near 43°N, 51.7°W.

The HIGH was drifting slowly eastward, and the LOW degenerated into a frontal wave as the circulation became elongated. The KINGDOM VENTURE was near 37°N, 62°W, with 55-kn winds and 20-ft seas. On the 24th, a LOW could no longer be analyzed with the frontal wave as the circulation became associated with a stationary LOW near Kap Farvel. The CRYOS had 55-kn winds and 20-ft waves off Newfoundland. The ANTON DOHRN, near 49°N, 41°W, was sailing into 50-kn winds and 33-ft swells. The BERGLJOT (52.2°N, 29.8°W) measured 52-kn winds and 26-ft waves. OWS Lima was tossed by 50-kn winds and 26-ft seas at 1200. The frontal system gradually eroded the maritime HIGH as another large cold HIGH helped the process. The gradient along the front weakened and retreated northward.

This storm came out of the southern Canadian Plains and moved across Ontario and Quebec Provinces. At 0000 on the 28th, it started affecting shipping as it entered the Gulf of St. Lawrence at 992 mb. The water had an immediate effect, and the storm deepened to 978 mb by 1200. As the center approached the Strait of Belle Isle, it curved northward. At 0000 on the 29th, the DON JOSE was near 53.5°N, 45°W, with 40-kn gales. The HUDSON was north of Hamilton Inlet very near the 960-mb center with only 30-kn winds; 12 hr later, things had changed as the LOW moved north of her position. At 1200, 60-kn winds were roaring out of the west with heavy snow. Thirty-five and 40-kn winds were blowing as far south as 40°N. The DON JOSE now had 20-ft seas. At 0000 on March 1, the HUDSON still had 55-kn winds which slowly slackened to 45 kn by 1200, which held until the 3d. By that time, the coast of Greenland had taken another toll.

Casualties--The British-registered 18,744-ton R. A. EMERSON was hove to, while 1,600 mi southeast of Halifax, on the 2d, due to damage by heavy seas. It was reported, on the 5th, that the 8,784-ton Norwegian TURANDOT had damage from heavy seas to deck cargo of chlorine gas. Poisonous fumes injured two crew members.

The Greek-registered GOOD VENTURE (12,149 tons) arrived Sydney with ice damage. The American EAGLE COURIER (16,443 tons) arrived Netherlands with alleged ice damage which occurred on the 24th.

The 37,783-ton Netherlands cruise ship ROTTERDAM encountered a freak wave estimated to be 60 to 98 ft (18 to 30 m) high off Casablanca that severely rolled the ship. No date was available.

Smooth Log, North Pacific Weather

January and February 1976

SMOOTH LOG, JANUARY 1976--There were fewer cyclones than normal this month, but fewer is not necessarily better, as it may mean those that did occur were larger and more intense. In the western ocean, the tracks were shifted about 5° latitude northward. A track extended across the La Perouse Strait to the southern tip of Kamchatka. The intercontinental track originated north of Tokyo and stretched eastward along 38°N to near 160°E where it turned gradually northeastward to enter the Gulf of Alaska slightly south of the Alaska Peninsula. Another track originated near midocean (35°N, 170°W) and entered the Gulf of Alaska near 50°N, 150°W.

The pressure pattern appeared normal, but the centers were more intense. The Aleutian Low at 990 mb, near 50°N, 170°E, was 9 mb lower than normal. A 993-mb secondary LOW was near 50°N, 172°W, versus a 1005-mb climatic Low in the Gulf of Alaska. The 1027-mb Pacific High was at 35°N, 132°W, as compared to a climatic 1020 mb at 30°N, 132°W. The high-pressure center near Great Salt Lake was 7-mb higher than normal.

There were three negative anomaly centers across the northern ocean--a 12 mb in the Sea of Okhotsk, a 10 mb near 51°N, 172°E, and an 11 mb near 53°N, 160°W. A positive 7-mb center near 40°N, 130°W, extended into the northwestern United States to an 8 mb north of Great Salt Lake.

The primary center of circulation at 700 mb was shifted eastward over southern Kamchatka rather than the Sea of Okhotsk and lower in height. An abnormal closed HIGH was centered near 31°N, 134°W. This increased the sharpness of the ridge that is normally located over the west coast of North America. A large negative anomaly encircled the northern ocean from the Alaska Peninsula to Mys Lopatka. A large positive center was located over the coast of Oregon.

Typhoon Kathy formed over the western ocean late in the month.

Extratropical Cyclones--The first significant storm of the month moved across the Tatar Strait on the 1st. As it moved over the Kuril Trench, it deepened rapidly to 978 mb. The SURUGA MARU, near 39°N, 140°E, found 45-kn gales. By 0000 on the 3d, the 978-mb LOW was near 44°N, 160°E. Two ships encountered 50-kn winds. They were the HAKUSAN MARU (36°N, 158°E) and the ZENKOREN MARU (39°N, 168°E). Other ships were reporting gales at various distances from the center. The MONTANA was pounded by 17-ft seas and 28-ft swells with 48-kn winds at 33.8°N, 155.8°E.

At 0000 on the 4th, the LOW was 960 mb, and the CHUETSUSAN MARU, near 46.5°N, 167°E, was 180 mi southwest of the center ploughing into 60-kn winds with mild 13-ft seas and swells. About 600 mi southeast of the center, along the front, the SEA FAN was fighting 60-kn southerly winds. The higher waves were far south of the center, between 30° and 40°N, with the highest--31 ft--reported by the OSAKA BAY near 34°N, 171°E.

On the 5th, the 970-mb LOW was headed due north along 170°E and into the Bering Sea. The LOW started filling rapidly over the cold water, and no longer existed late on the 6th.

A cyclonic circulation intensified over the eastern Sea of Japan late on the 7th. As it moved across Honshu, on the 8th, it split into a double LOW. The ERIDGE found 45-kn gales and 23-ft seas at 38.7°N, 154.8°E. The eastern center became the primary LOW on the 9th, and the ERIDGE fought 49-kn winds as she passed south of the center. At 1200, the MEISHUN MARU, near 48°N, 158°E, was sailing with heavy snow and 45-kn east-northeasterly winds.

At 0000 on the 10th, the 972-mb LOW was near 49°N, 160°E. Fifty-knot winds were reported on three sides of the center by the HOTAKA MARU, MEISHUN MARU, and Ostrov Paramushir. At 1200, the high winds were southwest of the center. Ostrov Ketoy measured 60-kn winds, and the MEISHUN MARU still had 50-kn winds at 47°N, 156°E. At this time, the LOW was nearly stationary with the highest wind of 45 kn. The HOTAKA MARU fought 33-ft swells near 48°N, 160°E.

On the 11th, another LOW was approaching from the east and, on the 12th, became the major circulation which meandered near Mys Lopatka until the 15th.

As the previous LOW moved northward, it left an area of weak gradient over the Sea of Japan. A 1008-mb LOW formed on the 11th and by the 12th was 993 mb near 36°N, 150°E. At 0600, the GRAND CARRIER (33.7°N, 148.9°E) measured 55-kn winds, while the EATON GLORIA (32°N, 146.2°E) measured 48-kn winds with 30-ft seas and 23-ft swells.

The center was racing northeastward at 40 kn on the 13th. The ASIA BOTAN measured 48-kn winds, 16-ft seas, and 21-ft swells at 38.5°N, 172.2°E. The DAISHIN MARU, DONA ROSSANA, and PRINCE MARU all found 40-kn gales. By 0000 on the 14th, the central pressure had dropped to 954 mb near 47°N, 170°W. Gale-force winds and waves to 20 ft were being reported. On the 15th, the IRISH STAR was pounded by 45-kn gales and 25-ft swells. The SPERO also reported 25-ft swells. The EL SALVADOR MARU was near 38°N, 169°W, and the swells were coded as 49 ft with 40-kn winds. All the above reports were 500 to 700 mi south of the center. By the 16th, the LOW was filling as it approached the Alaska Peninsula and was absorbed by another system on the 17th.

This storm moved out of the Sea of Japan on the 14th. Gale-force winds were reported on the 15th. At 0000 on the 16th, the 972-mb LOW was near 46°N, 172°E. The SEA-LAND COMMERCE was at 34.8°N, 172.2°E, at 0300, with 50-kn winds and giant 30-ft seas. Two ships farther north and closer to the center reported 40-kn gales. At 1200 the center had split into two

LOWs. By 0000 on the 17th, the eastern center was the dominant one. The GOLDEN ARROW was near 44°N, 178°E, with 50-kn northwesterlies and 16-ft waves. The PACDUKE (41.3°N, 178.9°E) measured only 42-kn winds with 13-ft seas, but the swells were 33 ft.

On the 18th, the AKAISHI MARU, near 46°N, 176°W, boasted of 45-kn gales and 20-ft waves. Other ships were reporting 20- to 23-ft swells. As the storm approached the Alaska Peninsula, it started losing strength and moved over the mainland on the 19th.

This LOW was associated with frontalgenesis over the northern Philippine Sea. It tracked more northerly than most storms that form over this area. Late on the 18th, it was moving nearly due north. Three ships reported 40-kn gales on the charts. At 0000 on the 19th, the 975-mb LOW was near 46°N, 161°E (fig. 53). The SEA-LAND FINANCE (41°N, 168°E) and the KENJYU MARU (42.5°N, 154°E) both radioed 50-kn reports. Farther north and east of the center, the ROKKOHSAN MARU, near 47°N, 167°E, fought 55-kn winds and 25-ft seas. Later that day, the storm absorbed another LOW that was over the Sea of Okhotsk and at 1200 was 960 mb, near 53°N, 160°E. Ostrov Beringa measured 70-kn winds. One of the Kuril Islands reported 50-kn winds. The KANEYOSHI MARU (53°N, 165°E) had 25-ft swells on the port side.

The storm moved northwestward into the Sea of Okhotsk, on the 20th, and the WAKANESAN MARU contended with 33-ft swells near 53°N, 165°E. The LOW circled over the Sea of Okhotsk and dissipated on the 21st.

A front stretched from Alaska to Hawaii on the 19th separating two high-pressure areas. Approximately midway along the front a wave developed and intensified rapidly. At 0000 on the 20th, it was 984 mb near 43°N, 153°W, with no high winds or waves plotted. As usual, there were very few reports for 1200 in the eastern half of the ocean. The 0000 chart of the 21st was loaded. The KODIAK and PACSTAR both found 45-kn winds south of Alaska Peninsula near 54°N, 159°W. The seas were only running about 16 ft. At 1800 the SINCLAIR TEXAS, at 54.4°N, 140.7°W, was devastated by 50-kn winds and 41-ft seas. The PHILADELPHIA nearby had 48 kn and 25-ft seas at 1200.

By 0000 on the 22d the LOW had disappeared over the Gulf of Alaska.

This incipient circulation was first discovered on the 0600 chart of the 21st in the southwestern quadrant of another LOW. At 1200, the tightened gradient brought 50-kn winds to the ASIA MARU, near 32°N, 149°E. The center of circulation moved northeastward and deepened rapidly. Forty- to 45-kn gales were found along 35°N, but the highest seas of up to 23 ft were along 30°N. At 1200 on the 22d, the LOW was on a northward track and of the same strength as the parent LOW near Mys Lopatka. Winds up to 55 kn were reported around that system by the SHIMA MARU, near 47°N, 158°E, with waves to 26 ft.

At 0000 on the 23d, the TONAMI MARU was north of the center, near 50.5°N, 179°W, with 60-kn easterly winds. At 0600, the GOLDEN ANNE (30.6°N, 154.3°E) radioed 45-kn winds, 12-ft seas, and powerful 30-ft swells. At 1200, the 964-mb LOW with two subcenters covered the western ocean south to 25°N and east to 150°W. Even though the circulation was large, the gradient produced winds in the 40-kn category, but the swell heights were increasing. Between latitudes 30° and 35°N in the eastern longitudes, there were many reports of swells over 20 ft. There were isolated reports of winds of 50 kn. On the 24th, the circulation started breaking down into many subcenters. The subject LOW circled south of the Aleutians until disappearing on the 26th.

This was one of the subcenters of the previous storm. It developed, near 34°N, 173°W, as a wave on a developing front. A report from the CAPE ESAN was the initial cue to its formation on the 0000 chart of the 25th. Twenty-four hours later at 0000 on the 26th, the 960-mb LOW was near 44°N, 155°W. The ZENKOREN MARU No. 5 was very near the center with 45-kn northeasterly winds. To the south, near 35°N, 164°W, the AGANO MARU was suffering 50-kn winds and 20-ft waves. Even farther to the northeast, near 50°N, 128°W, a ship whose call letters were obscured by the analysis fought 65-kn southerly winds. Not far away, the GRACE encountered 45-kn gales.

On the 27th, many ships were reporting gales. The PACIFIC LOGGER, at 52°N, 144°W, reported 50-kn winds. At 1200, the PORTLAND was pounded by 28-ft swells on the starboard side. At this time, the LOW was moving ashore near Yakutat to become lost in the mountains.

This was a late-forming subcenter of that large cyclonic circulation over the northern ocean. It was first detected at 0600 on the 26th, near 43°N, 162°E. Within 18 hr, it was howling at up to 60 kn by actual reports (fig. 55). The FRESNO CITY, near 41°N, 167°E, caught the 60-kn wind. Two ships near 40°N, 170°E, one the ASIA BRIGHTNESS, found 50- and 55-kn reports. The FRESNO CITY, near 41°N, 167°E, and the ASIA BRIGHTNESS, near 40.2°N, 172.2°E, caught the 60-kn winds with the latter mauled by 41-ft seas. Other ships in the area found 50- and 55-kn winds and 26-ft seas. Other ships in the southern quadrant found 35- to 45-kn winds and waves up to 20 ft.

The 954-mb center was headed toward the northeast on the 28th. The PRESIDENT VAN BUREN was hit by 45-kn winds. On the 29th, the LOW entered Bristol Bay where it disappeared on the 30th.

Tropical Cyclones, Western Pacific--For the second year in a row and the 10th time since 1945, the western North Pacific spawned a January typhoon. Kathy came to life near 6°N, 148°E, on the 28th. As a tropical storm, she headed west-northwestward, passing northeast of Yap Island on the 30th. She became a typhoon that same day. However, Kathy was already beginning to recurve toward the northeast. She reached her peak the following day as winds rose to 80 kn near her center, shortly after crossing the 15th parallel. On the 1st, the 3JGF encountered 40-kn northwesterlies in 20-ft seas some 200 mi southwest of the center. Late in the day Kathy was downgraded to tropical storm status and was turning extratropical. She completed this transformation on the 2d.

Casualties--On the 3d, it was reported that the 11,720-ton Liberian bulkcarrier ROSE S. with a cargo of scrap and logs was diverted toward Honolulu with flooding in the No. 1 hold in rough seas and high winds. The 9,241-ton MISS PAPALIOS struck a reef and ran aground near 16°N, 112.5°E, on the 2d. During severe weather on the 23d to 25th, cracks appeared with flooding. Ship was abandoned by crew.

SMOOTH LOG, FEBRUARY 1976--There were three major storm tracks this month, all slightly different from their climatological counterparts. The first was from along the southern coast of Japan and curved northward toward the Kamchatka Peninsula. The second, from approximately 35°N, 155°E, curved northeastward to the Alaska Peninsula. The third was from near 35°N, 160°W, to Sitka. The number of storm centers was near normal.

Climatically, the Aleutian Low has three centers, the two deeper ones over the western ocean and a third over the Gulf of Alaska. This month there were four centers with the deepest two (1005 mb) over the eastern ocean. In this case, "deep" is relative as none of the four were as intense as climatology indicates. The fourth LOW was over the Sea of Okhotsk. The Pacific High at 1024 mb was 4-mb higher than normal and about 10° longitude to the east.

In general, all of the North Pacific north of 25°N was above normal in pressure. There was one large positive anomaly from coast to coast with a 9-mb center. An 8-mb subcenter was over eastern Siberia. The two small negative centers were not over the shipping lanes. A negative 5-mb center was centered over the northern Sea of Okhotsk, and a small 3-mb center was near Sitka, Alaska.

The upper-air zonal flow between 30° and 50°N was normal. A closed center at 700 mb over Kamchatka was replaced by only a trough farther west over the Sea of Okhotsk. A shallow anomalous trough was over the Alaska Peninsula displacing the normal ridge westward.

There was one tropical storm, Lorna, near the end of the month.

Extratropical Cyclones--This LOW formed south of Kyushu in conjunction with frontogenesis. It was a 992-mb center after passing south of Tokyo on the 5th. At 0000 on the 6th, the SHINTO MARU was 200 mi south of the LOW with 45-kn gales. North and east of the center, DAIHO MARU and HONGKONG CONTAINER had 40-kn winds. The PRESIDENT PIERCE, southwest of the center, found 47-kn winds and 25-ft waves. By 0000 on the 7th, the 956-mb center, near 45°N, 160°E, had a circulation which covered the western third of the ocean. The ALASKAN MAIL, at 38.5°N, 161.8°E, was ravaged by 65-kn hurricane-force winds driving 39-ft waves. The BARON RENFREW, at 40°N, 174°E, had 60-kn southerly winds east of the occlusion. The seas were 20 ft and the swells 26 ft. The SANYU MARU was north of the center with 50-kn winds, and another ship was 500 mi to the south with 50 kn and 23-ft swells. There were five reports of 50-kn winds north and west of the center, two of which were island measurements. The EUROPEAN HIGHWAY (52°N, 165°E) had 50-kn winds and 23-ft seas. The AKAISHI MARU, near 47°N, 156°E, had only 40-kn gales, but the swells were 33 ft. Far to the south, the KOWLOON BAY, near 35°N, 150°E, had 30-ft swells with 20-ft seas.

On the 8th and 9th, the LOW was stationary near 49°N, 166°E. Gale-force winds continued to blow in all quadrants. The BELMAR (53.3°N, 173.5°E) and the COLORADO (51.4°N, 159.5°E) both had 50-kn winds and waves to 23 ft. The LOW started moving eastward again on the 10th, but it was deteriorating in intensity as minor Lows formed in the southeast quadrant. The last significant report was by the ROKKOHSAN MARU, at 0000 on the 11th, with 40-kn winds and 23-ft seas.

A front stretched southward from a LOW over the Sea of Okhotsk. This LOW formed in an area of weak pressure gradient, on the 3d, and moved eastward. On the 5th, the 988-mb center was near 28°N, 172°W. The TRANSONEIDA, at 24.2°N, 169.5°W, was hit by 50-kn winds and 33-ft seas just ahead of the front. The HOEGH OPAL was northwest of the center with 45-kn gales and 23-ft seas. On the 6th, the TOYOTA MARU passed through the front with 45-kn winds, 25-ft seas, and 30-ft swells. The FEDERAL NAGARA, at 29.5°N, 166°W, measured 49-kn winds and 20-ft seas.

The LOW raced northward on the 7th as a weak system between two high-pressure areas. The HERMINA found 45-kn gales and 25-ft waves as the center roared past. On the 8th, the center moved into the Gulf of Alaska and combined with another LOW to form a deep storm again. The NEWARK and PHILADELPHIA were both in the Gulf and reported 52-kn winds with 21-ft waves and 50-kn winds with 20-ft waves, respectively. On the 9th, the NEWARK experienced 52-kn winds, 20-ft seas, and 36-ft swells. At this time the original LOW was gone, and another center moved inland.

This storm formed in an area of weak pressure gradient east of Tokyo on the 11th. It quickly changed that situation with a well-developed circulation. By 0000 on the 12th, the 984-mb LOW was near 39°N, 157°E. The ST. LOUIS MARU was near 37.5°N, 156°E, with 55-kn storm winds and 20-ft seas and swells. Twelve hours later, the NICHIWA MARU (33°N, 149°E) radioed 45-kn winds and 31-ft swells. The strongest winds continued in the western quadrant as the storm moved slowly eastward for this latitude. The BELMAR reported 55-kn winds and 26-ft seas. The UNIVERSE KURE measured 55-kn winds and 15- to 20-ft seas. The LIECHTENSTEIN, at 32.2°N, 153.3°E, measured 60-kn winds and 30-ft seas.

By 1200 on the 13th, the strong wind band appeared to have shifted to the southern quadrant. The SEIZAN MARU found 55-kn winds at 34°N, 166°E, and about 100 mi to the southeast the YAMASHIN MARU was tossed by 40-kn winds and 33-ft swells. On the 14th, another LOW developed northeast of the original one. The HERMINA (34°N, 164°E) sailed into 45-kn gales and 33-ft swells. On the 14th, the original LOW disappeared.

A front stretched across Japan from near Tokyo to the East China Sea. Several stable waves formed and dissipated prior to the formation of an unstable wave

(Continued on page 242.)

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

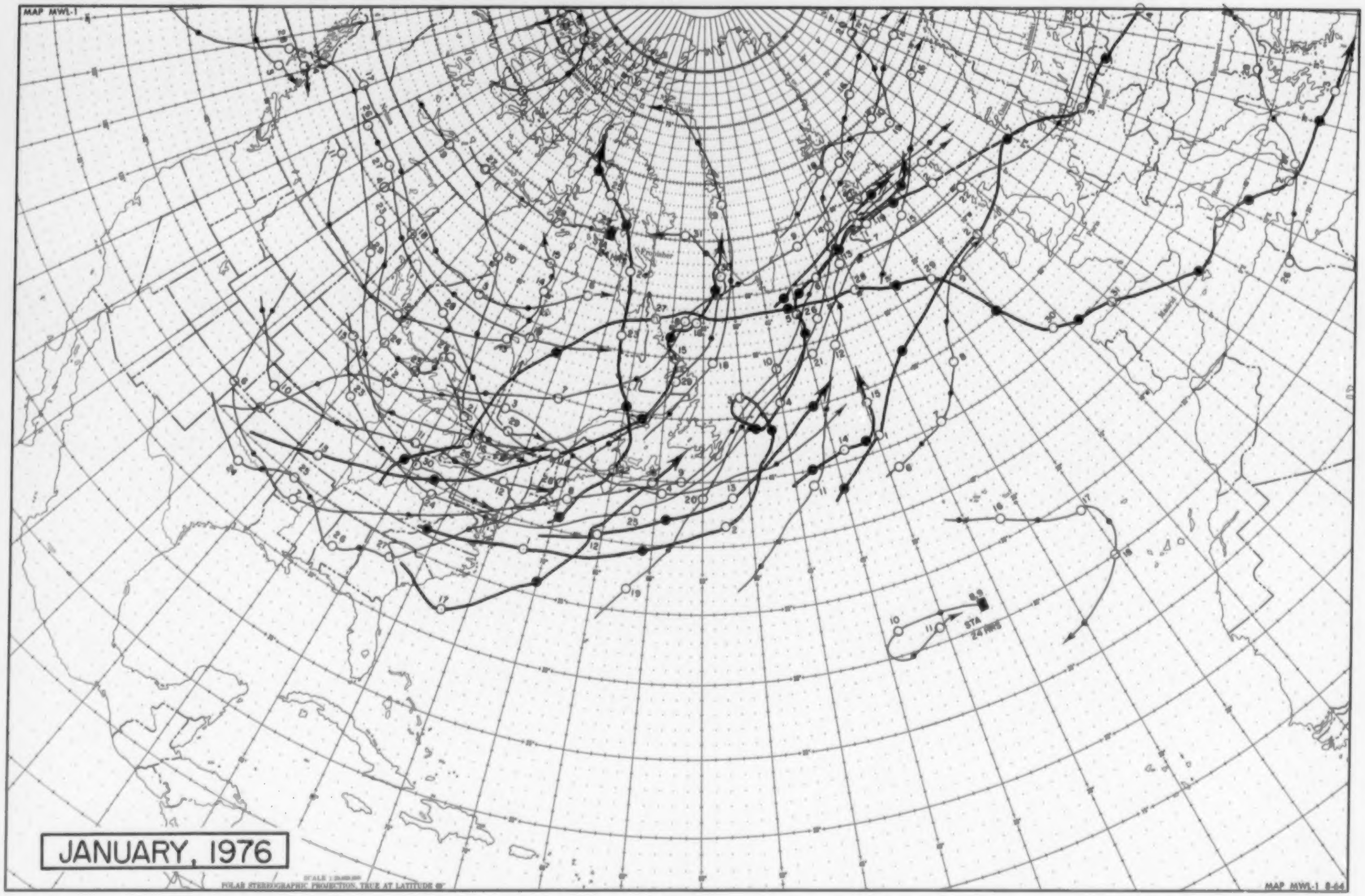


Figure 41. -- Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

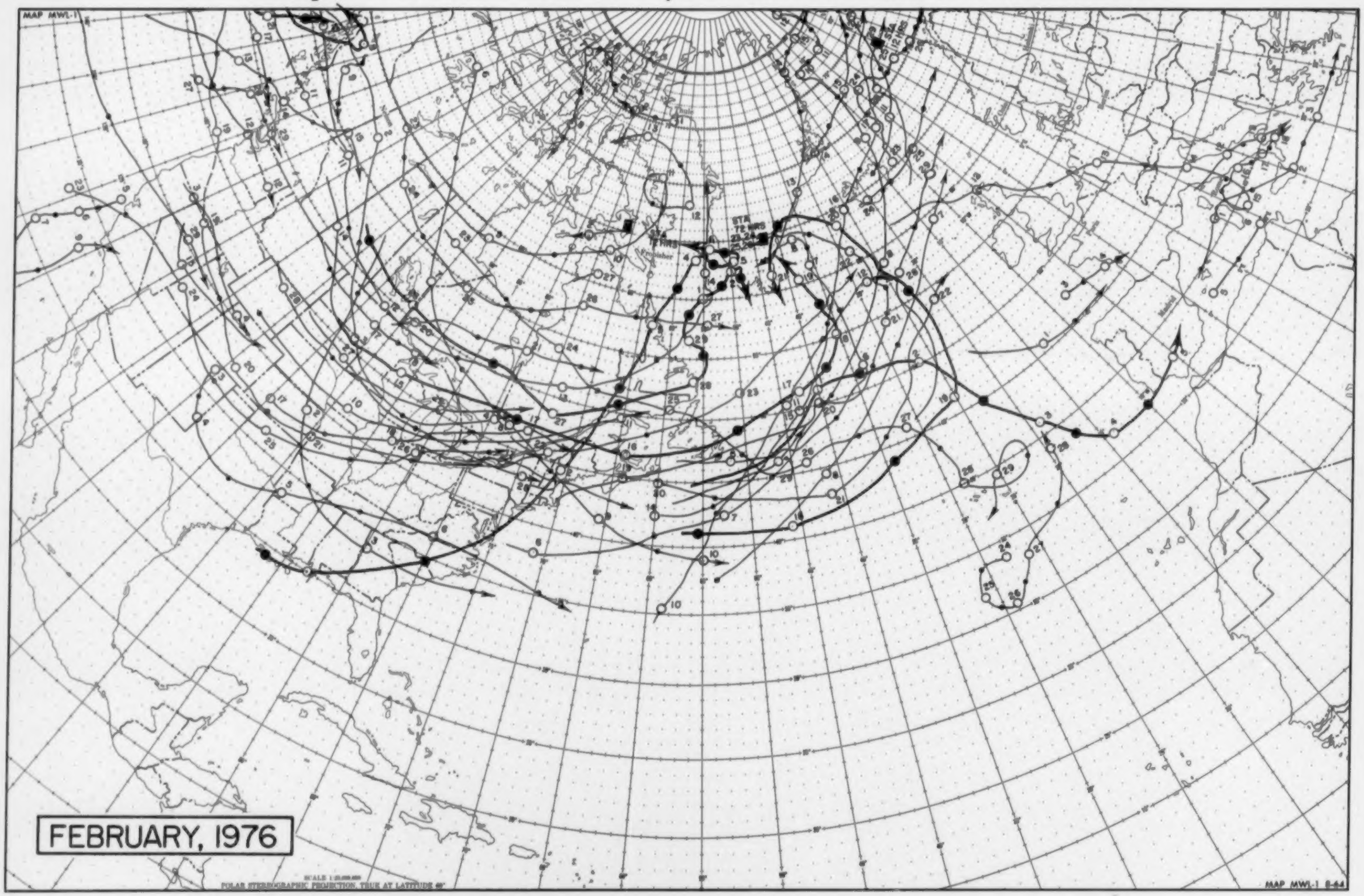


Figure 42. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

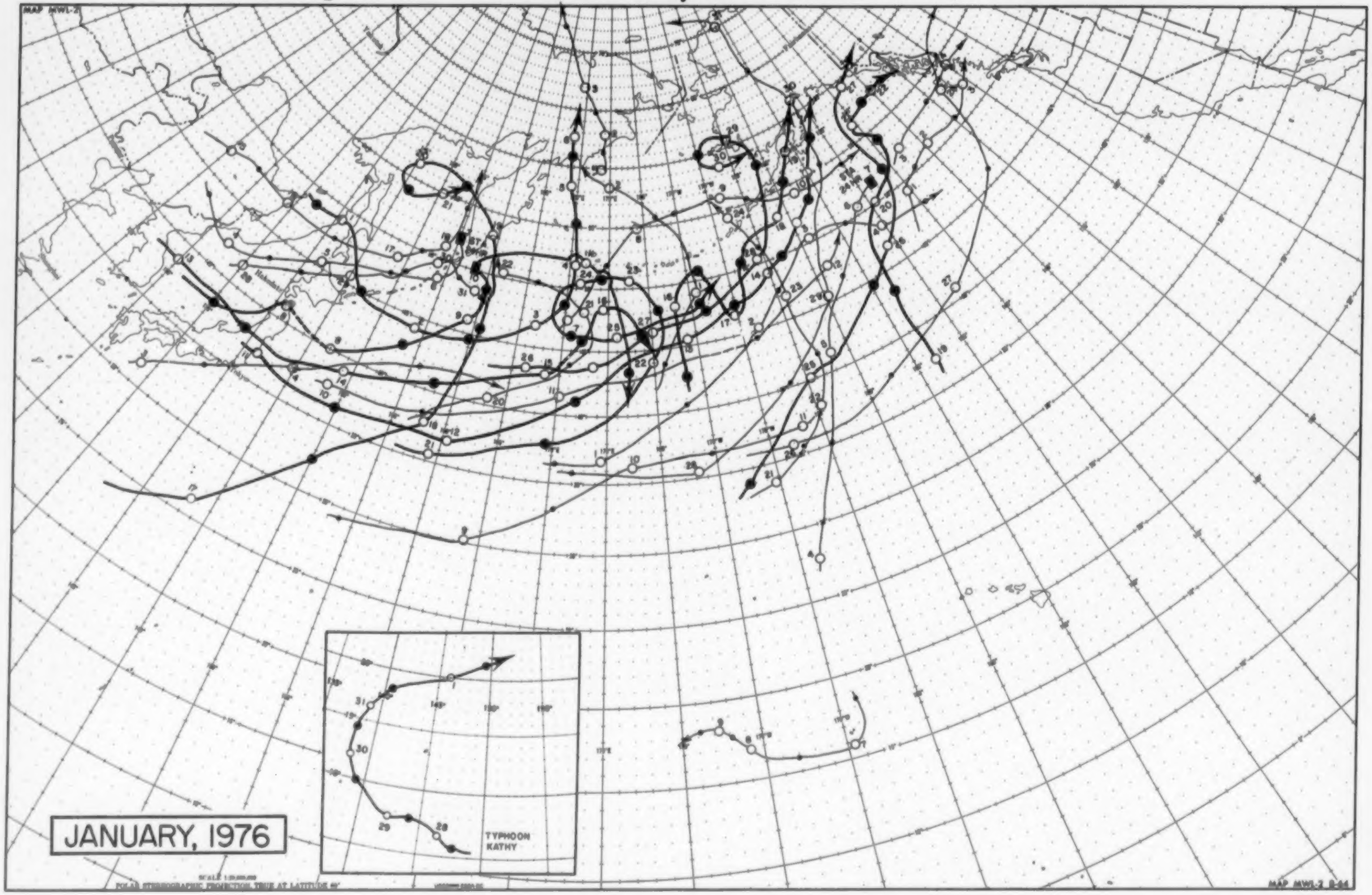


Figure 43. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

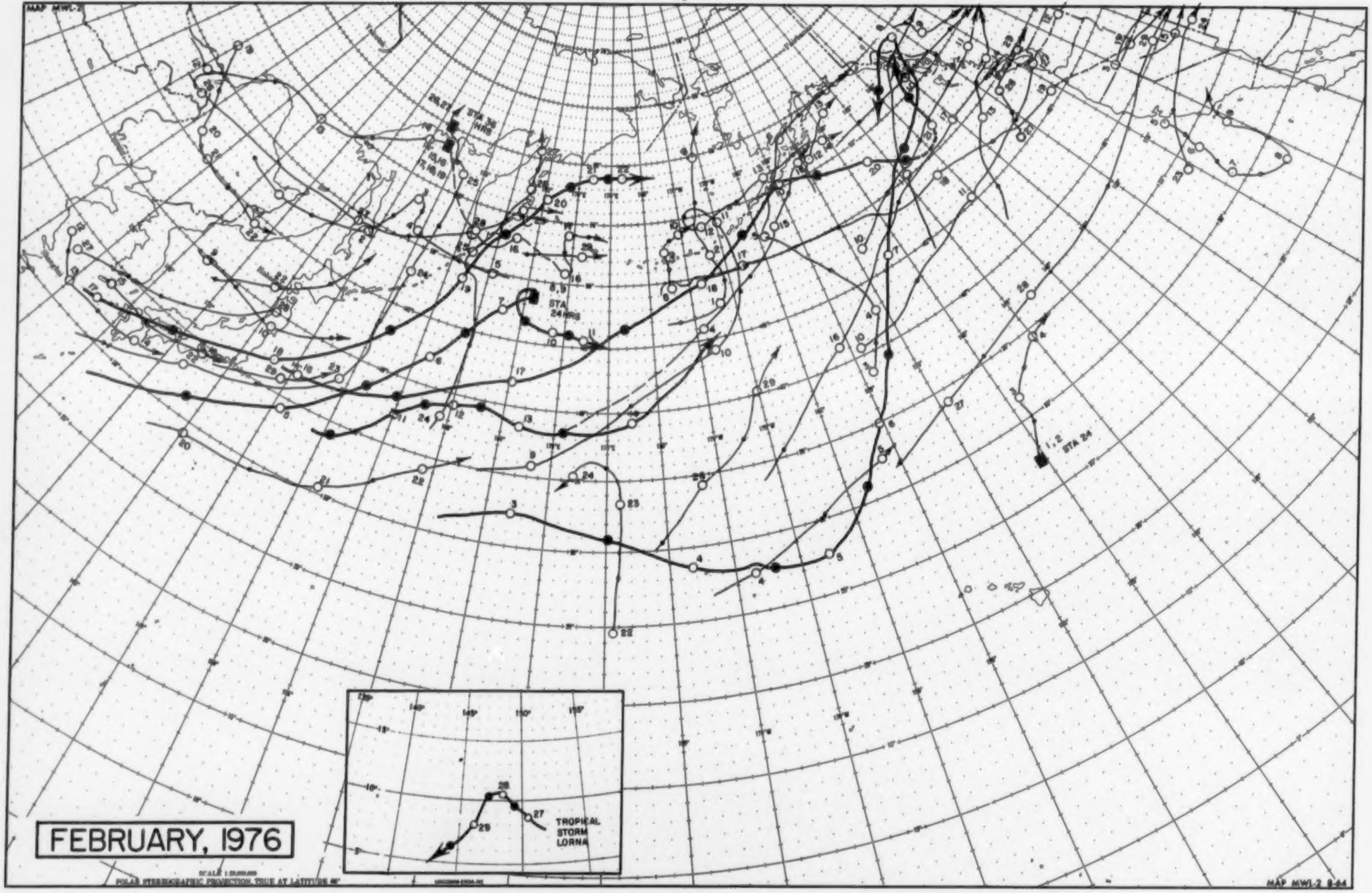


Figure 44. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 9

U. S. Ocean Weather Station Climatological Data, North Atlantic

Ocean Weather Station 'HOTEL' 38°00'N 71°00'W **January and February, 1976**

MEANS AND EXTREMES

	DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)				
MONTH	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR
JAN	- 3.0	23 15	9.3	20.7	03 21	- 7.1	19 06	4.4	17.0	04 00	11.5	*23 21	15.9	22.7	03 15	-10.2	*05 19	- 6.6	4.6	14 09
FEB	.1	07 21	10.8	19.6	22 15	- 6.1	08 06	6.1	16.2	02 06	10.0	26 06	13.7	15.6	21 21	-13.3	07 21	- 3.0	4.9	22 12

	MEANS AND EXTREMES: PRESSURE (MB)					PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS): TOTAL CLOUD				LOW CLOUD				DAYS WITH SPECIFIED WEATHER										
MONTH	MIN	DA HR	MEAN	MAX	DA HR	0-2	3-5	6-7	8 & OBSC	0-2	3-5	6-7	8 & OBSC	PCPN	RAIN OR DRZL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
JAN	994.8	*18 00	1018.5	1039.2	19 21	9.0	19.7	34.4	36.9	23.4	25.4	28.3	23.0	18	18	8	0	1	12	6	0	30	16.9	244
FEB	982.4	02 09	1018.9	1037.6	*15 12	25.3	21.8	23.1	29.7	47.2	21.0	19.7	12.2	13	13	3	1	0	8	1	1	28	11.8	229

** VV-90-93 AND/OR W=4 COMP OB DAYS=COMPLETE OB DAYS

Wind

JAN WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.6	1.9	4.7	2.0	1.6	.0	11.0	18.9
NE	.5	.4	.4	.1	.4	.0	2.3	15.5
E	.0	1.2	1.4	.0	.0	.0	2.7	11.6
SE	.1	.4	1.6	.0	.0	.0	2.2	13.0
S	.3	.3	4.7	6.7	1.5	.0	13.5	23.6
SW	.0	1.3	7.9	4.5	1.8	.0	11.6	21.4
W	.0	1.4	5.4	6.6	3.2	.0	16.8	24.6
NW	.9	3.2	4.7	19.9	6.9	.8	38.4	26.5
CALM	1.6	.0	.0	.0	.0	.0	1.6	.0
TOTAL	4.1	10.2	31.6	39.8	13.5	.8	100.0	22.2

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
244	220	58	14 1230	12.9	286	

FEB WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	1.3	5.5	3.6	.0	.0	10.4	21.9
NE	.0	1.0	2.7	.0	.0	.0	3.7	11.4
E	.0	.0	2.9	.0	.0	.0	2.9	15.0
SE	.0	1.3	1.9	.0	.0	.0	3.2	11.0
S	.4	4.0	4.0	2.6	.3	.3	11.8	16.0
SW	.0	2.9	8.6	6.1	2.4	.5	20.0	21.7
W	.0	4.4	8.8	7.3	1.5	1.3	23.4	21.3
NW	.4	2.7	6.1	13.8	.5	.0	23.6	22.2
CALM	.4	.0	.0	.0	.0	.0	.4	.0
TOTAL	1.3	17.9	38.4	33.4	4.8	2.2	100.0	20.1

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
229	260	70	02 1200	11.3	273	

Wave

JAN WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	3.4	2.8	1.7	3.0	.4	.0	.0	11.3
NE	.0	.7	.5	.9	.0	.0	.0	.0	2.2
E	.0	1.5	.0	.0	.0	.0	.0	.0	1.5
SE	.0	1.1	.1	.0	.0	.0	.0	.0	1.2
S	.0	3.1	6.3	1.9	3.8	.0	.0	.0	15.2
SW	.8	3.0	3.7	2.3	2.9	.4	.0	.0	13.1
W	.0	2.4	4.8	3.4	3.7	1.3	.0	.0	15.6
NW	.0	4.1	5.2	6.6	16.1	1.3	.0	.0	33.3
IND	.0	3.7	.4	.0	.4	.0	.0	.0	4.5
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.8	23.0	23.8	16.8	29.9	3.7	.0	.0	100.0

NUMBER OF OBS 244 IND-INDETERMINATE

FEB WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	2.6	6.0	2.6	.3	.0	.0	.0	13.5
NE	.0	.9	.8	.0	.0	.0	.0	.0	1.6
E	.0	1.3	.0	.0	.0	.0	.0	.0	1.3
SE	.0	1.3	.0	.0	.0	.0	.0	.0	1.3
S	.0	4.3	2.3	.0	.3	.3	.0	.0	7.2
SW	.9	9.1	6.0	1.1	6.0	.3	.3	.0	23.9
W	.0	5.0	7.3	3.3	3.7	.4	1.4	.0	21.2
NW	.0	3.9	2.7	9.6	2.7	.0	.0	.0	19.0
IND	.0	9.2	1.7	.0	.0	.0	.0	.0	10.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.9	37.6	28.8	16.6	13.1	1.3	1.7	.0	100.0

NUMBER OF OBS 229 IND-INDETERMINATE

JAN WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.8	9.4	7.8	.0	.0	.0	.0	.0	18.0
6-7	.0	9.0	11.5	12.3	13.1	.0	.0	.0	45.9
8-9	.0	.8	5.7	3.7	14.3	2.5	.0	.0	27.0
10-11	.0	.0	.4	.8	2.0	1.2	.0	.0	4.5
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	3.7	.4	.0	.4	.0	.0	.0	4.5
TOTAL	.8	23.0	23.8	16.8	29.9	3.7	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR
244	7.5	10	300	SEA	23 09

IND-INDETERMINATE (DIR IN DEGREES)

FEB WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.4	16.6	13.1	.0	.0	.0	.0	.0	30.1
6-7	.4	11.4	10.9	15.3	7.0	.0	.0	.0	45.0
8-9	.0	.4	3.1	1.3	5.7	1.3	.4	.0	12.2
10-11	.0	.0	.0	.0	.4	.0	.0	.0	.4
12-13	.0	.0	.0	.0	.0	.0	1.3	.0	1.3
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	9.2	1.7	.0	.0	.0	.0	.0	10.9
TOTAL	.9	37.6	28.8	16.6	13.1	1.3	1.7	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR
229	9.0	12	250	SWL	02 18

IND-INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

Table 10
U. S. Ocean Buoy Climatological Data
January and February 1976

JANUARY DATA SUMMARY EB01
AVERAGE LATITUDE 36.0N AVERAGE LONGITUDE 147.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-04.4	(22 15)	02.0	05.2	(30 03)	244	31
DEWPOINT TEMP (DEG C)	-08.6	(22 18)	-00.2	04.7	(30 03)	245	31
PRESSURE (MBAR)	0963.3	(27 00)	0998.3	1022.3	(01 03)	245	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	.4	2.1				2.9	10.9
NE		.8	6.2	.8			7.9	15.4
E		1.7	12.8	6.2			20.7	18.5
SE	.8	.8	3.7	4.1	.4		9.9	20.4
S		2.9	12.8	3.7	.4		19.8	17.9
SW		1.2	9.5	4.5	1.2	.4	15.7	20.7
W	.4	1.2	8.7	3.7			14.0	17.7
NW		2.9	6.2				9.1	13.4
CALM								
TOTAL	1.7	12.0	60.7	23.1	2.1	.4	100.0	17.9

NO. OF OBS: 242
MAX WIND
SPEED: 49 KNOTS
DIRECTION: 210 DEG
DAY: 30
HOUR: 06

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 236

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		1.7	30.9	35.6	28.8	2.5	.4		3.3M	9.0M	(30 12)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 18 NO. OF DAYS WITH REPORTS/ COMPLETE: 30 PARTIAL: 1
NO. OF OBS WITH PAST OR PRESENT PRECIP: 38 NO. OF WEATHER OBS: 38

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 2.1% SEVERE: NONE #OBS: 243

FEBRUARY DATA SUMMARY EB01
AVERAGE LATITUDE 36.0N AVERAGE LONGITUDE 147.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-04.9	(24 06)	01.0	04.0	(06 09)	221	29
DEWPOINT TEMP (DEG C)	-08.0	(23 21)	-01.7	03.0	(06 03)	202	29
PRESSURE (MBAR)	0975.9	(22 15)	1004.5	1033.2	(03 06)	222	29

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 219

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		10.5	40.6	28.3	17.4	2.3	.9		3.0M	8.5M	(08 18)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 11 NO. OF DAYS WITH REPORTS/ COMPLETE: 23 PARTIAL: 6
NO. OF OBS WITH PAST OR PRESENT PRECIP: 31 NO. OF WEATHER OBS: 31

JANUARY DATA SUMMARY EB04
AVERAGE LATITUDE 26.0N AVERAGE LONGITUDE 090.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	16.8	(30 03)	18.0	19.9	(31 21)	16	2
DEWPOINT TEMP (DEG C)	06.8	(30 00)	09.3	13.3	(31 21)	16	2
SEA TEMP (DEG C)	20.7	(30 12)	21.0	21.6	(30 21)	16	2
AIR-SEA TEMP (DEG C)	-04.4	(31 03)	-03.1	-01.2	(31 18)	16	2
PRESSURE (MBAR)	1010.7	(31 21)	1018.7	1023.0	(30 03)	16	2

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N								
NE								
E								
SE								
S	6.3		18.8				25.0	11.0
SW		6.3	6.3				12.5	10.0
W	12.5	18.8					31.3	4.2
NW		25.0	6.3				31.3	9.4
CALM								
TOTAL	18.8	50.0	31.3				100.0	8.3

NO. OF OBS: 16
MAX WIND
SPEED: 17 KNOTS
DIRECTION: 180 DEG
DAY: 31
HOUR: 18

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 11

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	72.7	27.3							.6M	1.0M	(30 06)

FEBRUARY DATA SUMMARY EB04
AVERAGE LATITUDE 26.0N AVERAGE LONGITUDE 090.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.6	(08 06)	18.8	23.6	(06 18)	59	9
DEWPOINT TEMP (DEG C)	07.0	(02 18)	14.0	23.0	(06 18)	48	9
SEA TEMP (DEG C)	20.7	(02 12)	21.4	22.2	(06 21)	59	9
AIR-SEA TEMP (DEG C)	-07.9	(08 06)	-02.6	01.9	(06 18)	59	9
PRESSURE (MBAR)	1007.7	(01 06)	1019.6	1024.1	(09 15)	59	9

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		8.5	8.5	1.7			18.6	14.1
NE								
E		6.8	15.3				22.0	13.6
SE		3.4	6.8				10.2	12.7
S		6.8	5.1				11.9	10.6
SW		5.1					5.1	4.7
W		1.7	1.7	8.5			11.9	23.3
NW		6.8	11.9				18.6	11.5
CALM	1.7						1.7	.0
TOTAL	1.7	39.0	49.2	10.2			100.0	13.3

NO. OF OBS: 59
MAX WIND
SPEED: 33 KNOTS
DIRECTION: 280 DEG
DAY: 01
HOUR: 09

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 43

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	32.6	53.5	11.6	2.3					1.1M	3.0M	(02 03)

JANUARY DATA SUMMARY EB15
AVERAGE LATITUDE 32.3N AVERAGE LONGITUDE 075.2W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	06.7	(18 18)	16.2	22.4	(01 00)	244	31
SEA TEMP (DEG C)	20.9	(20 12)	21.7	23.2	(01 00)	243	31
AIR-SEA TEMP (DEG C)	-14.5	(18 18)	-05.6	00.3	(08 18)	241	31
PRESSURE (MBAR)	0996.7	(17 18)	1020.3	1033.4	(19 15)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		6.5	10.8	4.1			21.1	15.1
NE	.4	2.8	1.6				4.9	8.8
E	.4	1.6	2.0				4.1	9.7
SE	.4	.8	3.3	3.7			8.1	19.1
S	.4	2.0	5.7	11.4			19.5	20.5
SW		.8	4.9	4.9			10.6	21.1
W	.8	1.2	4.3	7.7	2.4		16.7	22.5
NW	.4	.4	4.5	9.8			15.0	22.3
CALM								
TOTAL	2.8	16.3	37.0	41.5	2.4		100.0	18.9

NO. OF OBS: 246
MAX WIND
SPEED: 36 KNOTS
DIRECTION: 290 DEG
DAY: 17
HOUR: 21

FEBRUARY DATA SUMMARY EB15
AVERAGE LATITUDE 32.3N AVERAGE LONGITUDE 075.3W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.9	(07 21)	17.8	21.5	(23 00)	224	29
SEA TEMP (DEG C)	20.5	(28 15)	21.3	23.0	(02 12)	220	29
AIR-SEA TEMP (DEG C)	-12.3	(07 21)	-03.5	00.3	(23 00)	219	29
PRESSURE (MBAR)	0996.9	(02 03)	1021.8	1034.8	(24 15)	225	29

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		1.8	7.5	2.2			11.5	17.1
NE		1.3	3.1	.9			5.3	13.7
E		6.6	5.3				11.9	11.0
SE		1.8	5.3	1.3			8.4	14.3
S		1.8	6.2	4.4	.4		12.8	19.3
SW		1.8	15.9	7.5	.4		25.7	19.4
W		7.1	4.4	2.2	1.3		15.0	16.1
NW		1.8	3.1	4.0			8.8	18.3
CALM	.4						.4	.0
TOTAL	.4	23.9	50.9	22.6	2.2		100.0	16.9

NO. OF OBS: 226
MAX WIND
SPEED: 47 KNOTS
DIRECTION: 230 DEG
DAY: 02
HOUR: 03

JANUARY DATA SUMMARY EB16
AVERAGE LATITUDE 42.5N AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	07.6	(25 09)	10.0	12.3	(04 15)	238	31
SEA TEMP (DEG C)	09.9	(26 12)	10.7	11.6	(07 03)	240	31
AIR-SEA TEMP (DEG C)	-02.9	(24 18)	-00.6	01.9	(27 00)	236	31
PRESSURE (MBAR)	1014.7	(14 09)	1023.8	1033.7	(19 18)	242	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8		7.2	.8			8.9	15.1
NE	.4	2.5	11.0	.4			14.3	14.1
E	1.7	.8					2.5	4.4
SE		.4					.4	6.0
S	.4	5.5	10.5	2.5			19.0	14.8
SW	.4	6.3	12.2	6.3			25.3	16.6
W	.4	.4	17.7	3.0			21.5	18.3
NW		2.1	5.5	.4			8.0	13.0
CALM								
TOTAL	4.2	18.1	64.1	13.5			100.0	15.6

NO. OF OBS: 237
MAX WIND
SPEED: 33 KNOTS
DIRECTION: 290 DEG
DAY: 05
HOUR: 09

FEBRUARY DATA SUMMARY EB16
AVERAGE LATITUDE 42.5N AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	04.9	(29 00)	09.0	11.5	(17 09)	214	29
SEA TEMP (DEG C)	09.6	(18 21)	10.3	10.6	(02 12)	214	29
AIR-SEA TEMP (DEG C)	-05.2	(29 00)	-01.4	01.1	(17 09)	213	29
PRESSURE (MBAR)	1005.9	(26 03)	1018.6	1029.6	(10 18)	215	29

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.5	2.7	9.7	7.6			20.5	18.5
NE		.5	2.7	8.1			11.4	22.4
E	.5	.5	.5				1.6	9.3
SE		1.1	4.9	1.1			7.0	16.1
S	.5	3.2	5.4	2.2			11.4	14.9
SW	.5	.5	6.5	4.9			12.4	18.6
W		3.2	7.0	5.9			16.2	18.4
NW		2.7	13.0	2.7			18.4	17.2
CALM	1.1						1.1	.0
TOTAL	2.7	14.6	49.7	32.4			100.0	17.8

NO. OF OBS: 185
MAX WIND
SPEED: 29 KNOTS
DIRECTION: 180 DEG
DAY: 19
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 211

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		3.3	8.5	28.0	51.2	8.1	.9		4.2M	8.5M	(21 18)

JANUARY — DATA SUMMARY — E833
AVERAGE LATITUDE 50.5N — AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-03.3	(07 12)	02.7	06.9	(30 09)	156	31
SEA TEMP (DEG C)	03.9	(27 09)	04.8	05.8	(05 13)	152	31
AIR-SEA TEMP (DEG C)	-08.7	(07 12)	-02.1	01.0	(30 09)	150	31
PRESSURE (MBAR)	0962.7	(27 03)	1001.4	1022.1	(01 09)	149	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 145

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		4.8	.7				5.5	8.3
NE	.7	2.8	5.5	1.4			10.3	13.8
E	1.4	3.4	12.4	9.7			26.9	18.1
SE	.7	3.4	11.0	5.5			20.7	15.9
S	.7	3.4	12.4	2.1			18.6	14.6
SW		1.4	4.1	1.4			6.9	15.4
W	1.4	4.1	2.1				7.6	7.8
NW		2.8	.7				3.4	9.2
CALM								
TOTAL	4.8	28.2	49.0	20.0			100.0	14.7

MAX WIND
SPEED: 31 KNOTS
DIRECTION: 100 DEG
DAY: 28
HOUR: 03

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 5.5% SEVERE: NONE #OBS: 145

JANUARY — DATA SUMMARY — E834
AVERAGE LATITUDE 40.1N — AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-10.0	(23 15)	01.5	11.7	(14 06)	208	31
SEA TEMP (DEG C)	05.5	(30 18)	07.3	09.3	(09 06)	202	31
AIR-SEA TEMP (DEG C)	-16.1	(23 18)	-05.7	04.4	(27 15)	202	31
PRESSURE (MBAR)	0998.7	(22 06)	1018.7	1036.4	(19 21)	204	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 202

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.5	3.0	9.9	5.4			18.8	16.3
NE		1.0	3.5	1.0			5.4	15.5
E	1.0	1.0	1.5				3.5	10.3
SE	1.0	.5	2.0				3.5	10.1
S		2.0	9.4	1.5			12.9	15.0
SW		1.5	8.9	2.0			12.4	16.4
W	.5	4.0	7.4	8.4			20.3	17.9
NW		1.0	11.4	10.9			23.3	21.1
CALM								
TOTAL	3.0	13.9	54.0	29.2			100.0	17.1

MAX WIND
SPEED: 33 KNOTS
DIRECTION: 300 DEG
DAY: 23
HOUR: 06

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE:17.8% SEVERE: NONE #OBS: 202

JANUARY — DATA SUMMARY — E841
AVERAGE LATITUDE 38.7N — AVERAGE LONGITUDE 073.8W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-07.9	(23 15)	03.9	13.5	(14 06)	225	31
SEA TEMP (DEG C)	05.4	(23 12)	08.7	10.7	(01 18)	224	31
AIR-SEA TEMP (DEG C)	-16.3	(18 15)	-04.8	04.8	(29 00)	222	31
PRESSURE (MBAR)	0993.8	(01 09)	1018.9	1038.8	(19 15)	199	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 219

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.3	6.8	3.2			12.3	17.7
NE	.9	.9	.5	1.4			3.2	16.9
E		.9	2.3				3.2	13.0
SE	.5	.5	3.7				4.6	11.6
S	.5	2.3	14.0	.9			18.7	15.4
SW		2.3	7.8	1.8			11.9	15.8
W		3.3	5.3	9.1	1.4		18.3	21.1
NW	1.4	5.5	7.3	12.8	.9		27.9	18.5
CALM								
TOTAL	3.2	16.9	48.4	29.2	2.3		100.0	17.4

MAX WIND
SPEED: 35 KNOTS
DIRECTION: 300 DEG
DAY: 23
HOUR: 03

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 241

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	11.2	43.2	34.0	10.0	1.7				1.7M	4.0M	(14 09)

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE:12.3% SEVERE: NONE #OBS: 219

JANUARY — DATA SUMMARY — E810
AVERAGE LATITUDE 27.5N — AVERAGE LONGITUDE 088.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	09.8	(17 15)	16.8	23.2	(03 18)	156	20
DEWPOINT TEMP (DEG C)	02.2	(18 00)	12.4	22.2	(03 18)	152	20
SEA TEMP (DEG C)	21.0	(10 06)	22.0	22.8	(04 00)	65	10
AIR-SEA TEMP (DEG C)	-11.4	(09 00)	-04.3	00.7	(03 18)	65	10
PRESSURE (MBAR)	1013.7	(17 00)	1022.4	1032.8	(09 15)	156	20

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 155

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.3	1.3	10.3	7.7			20.6	18.0
NE	1.3	4.5	14.8				20.6	12.3
E		9.0	16.1				25.2	11.9
SE	.6	2.6	9.0				12.3	12.3
S	.6	1.9	3.2				5.8	9.8
SW		1.3	2.6				3.9	13.5
W		1.3	1.9	1.3			4.5	16.6
NW		.6		6.5			7.1	24.5
CALM								
TOTAL	3.9	22.6	58.1	15.5			100.0	14.3

MAX WIND
SPEED: 30 KNOTS
DIRECTION: 320 DEG
DAY: 17
HOUR: 09

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 152

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	11.8	67.8	15.8	4.6					1.3M	3.5M	(17 15)

FEBRUARY — DATA SUMMARY — E833
AVERAGE LATITUDE 50.5N — AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-02.8	(08 21)	01.8	04.2	(05 00)	184	29
SEA TEMP (DEG C)	03.5	(10 12)	04.5	05.4	(26 15)	180	29
AIR-SEA TEMP (DEG C)	-06.6	(08 21)	-02.7	00.2	(05 00)	180	29
PRESSURE (MBAR)	0971.6	(23 00)	1004.2	1041.6	(03 12)	182	29

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 183

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		3.3	.5		.5		4.4	12.3
NE		3.8	7.1				10.9	12.8
E		7.1	9.8	1.1			18.0	13.6
SE		7.1	7.7				14.8	11.0
S		6.6	8.2	1.1			15.8	13.8
SW		10.4	1.1	1.1	.5		13.1	11.5
W	.5	4.6	8.9				14.2	12.8
NW	.5	3.3	4.4				8.2	11.7
CALM	.5						.5	.0
TOTAL	1.6	45.9	48.1	3.3	1.1		100.0	12.3

MAX WIND
SPEED: 41 KNOTS
DIRECTION: 020 DEG
DAY: 28
HOUR: 21

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 1.1% SEVERE: NONE #OBS: 182

FEBRUARY — DATA SUMMARY — E834
AVERAGE LATITUDE 40.1N — AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-06.3	(03 03)	04.4	10.0	(22 15)	201	29
SEA TEMP (DEG C)	03.6	(18 03)	05.4	07.1	(02 12)	201	29
AIR-SEA TEMP (DEG C)	-12.9	(03 03)	-01.0	05.9	(17 21)	201	29
PRESSURE (MBAR)	0970.2	(02 09)	1016.9	1038.2	(19 03)	201	29

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 201

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.5	8.0	1.0			11.4	14.7
NE		2.0	2.5				4.5	12.6
E		1.0	2.5				3.5	13.3
SE		3.5	.5				4.0	6.8
S		3.0	10.0	.5			13.4	15.1
SW		3.0	22.9	4.5			30.3	17.0
W	.5	4.0	10.4	3.0			17.9	15.3
NW		1.0	8.5	4.5			13.9	18.0
CALM	1.0						1.0	.0
TOTAL	1.5	19.9	65.2	13.4			100.0	15.4

MAX WIND
SPEED: 31 KNOTS
DIRECTION: 290 DEG
DAY: 02
HOUR: 12

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 6.0% SEVERE: NONE #OBS: 201

FEBRUARY — DATA SUMMARY — E841
AVERAGE LATITUDE 38.7N — AVERAGE LONGITUDE 073.6W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-09.8	(07 12)	06.1	11.7	(19 03)	216	29
SEA TEMP (DEG C)	05.0	(11 03)	07.0	08.3	(08 00)	213	29
AIR-SEA TEMP (DEG C)	-12.0	(07 13)	-00.8	05.2	(11 03)	213	29
PRESSURE (MBAR)	0977.7	(02 06)	1018.1	1038.7	(19 06)	195	29

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 214

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.5	1.9	5.1	.9			8.4	16.2
NE	.9		3.7				4.7	12.8
E	.5	1.9	2.8				5.1	10.0
SE		1.4	3.3				4.7	12.0
S		1.9	16.4	3.3			21.5	17.6
SW		3.8	18.7	2.8			24.5	17.2
W		3.7	6.5	.9	.5		11.7	14.7
NW		2.8	11.7	4.7			19.2	17.8
CALM	.5						.5	.0
TOTAL	2.3	18.4	68.2	17.6	.5		100.0	16.1

MAX WIND
SPEED: 45 KNOTS
DIRECTION: 270 DEG
DAY: 02
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 207

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	12.1	56.5	25.6	5.3		.5			1.5M	6.5M	(02 12)

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 3.9% SEVERE: NONE #OBS: 214

JANUARY — DATA SUMMARY — E801
AVERAGE LATITUDE 28.5N — AVERAGE LONGITUDE 090.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	05.3	(08 21)	15.4	20.0	(24 18)	77	27
PRESSURE (MBAR)	1013.7	(31 18)	1023.6	1030.9	(09 21)	46	18

Table 11
Selected Gale and Wave Observations, North Atlantic
January and February 1976

Vessel	Nationality	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. 10°	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Temperature °C: Sea	Sea Waves: Period sec.	Sea Waves: Height ft.	Swell Waves: Dir. 10°	Swell Waves: Period sec.	Swell Waves: Height ft.
NORTH ATLANTIC OCEAN		JAN.															
CARBIDE TEXAS CITY	AMERICAN	1	34.5 N	76.2 W	06	23	60	10 NM	01	1000.3	15.0	20.5	6	19.5			
BECLA MAERSK	DANISH	1	34.1 N	47.8 W	00	36	41	5 NM	25	1001.0	17.0		3	6.5	36	7	11.5
SEALAND PRODUCER	AMERICAN	1	37.0 N	31.4 W	06	16	41	10 NM	03	1009.1	17.3	15.0	5	19.5	19	9	23
TAMPA	AMERICAN	1	34.3 N	72.1 W	12	24	50	2 NM		1001.3	20.0	20.0	8	19.5			
JESSIE STOVE	NORWEGIAN	2	36.9 N	65.8 W	06	36	42	10 NM	21	1012.0	13.5		11	16.5			
SEALAND RESOURCE	AMERICAN	2	49.7 N	20.9 W	12	28	45	5 NM	02	1004.0	11.6	8.9	4	10	26	8	24.5
LASH ESPANA	AMERICAN	3	38.1 N	40.2 W	18	27	45	10 NM	03	1002.4	15.0	17.7			27	7	8
SEALAND MARKET	AMERICAN	3	45.7 N	44.5 W	00	08	45	2 NM	81	984.1	14.4	7.8	4	6.5	19	10	10
PURE OIL	AMERICAN	3	31.6 N	80.0 W	18	19	M 41	10 NM	02	1019.3	22.7	25.0	3	6.5	XX	X	8
SEVILLAN REEFER	LIBERIAN	3	40.0 N	51.7 W	12	31	50	10 NM	01	1008.0	5.0	13.0	XX	16.5			
AMER ACE	AMERICAN	4	44.5 N	40.2 W	06	28	45	5 NM	25	1000.7	5.0	14.4	6	10	28	X	19.5
SEVILLAN REEFER	LIBERIAN	4	38.8 N	58.0 W	12	22	45	2 NM	60	1002.0	16.0	16.0	XX	16.5			
SEVILLAN REEFER	LIBERIAN	5	38.5 N	61.7 W	06	27	45	1 NM	61	1006.0	12.5	17.0	XX	19.5			
ERIKA SCHULTE	GERMAN	5	40.1 N	60.8 W	06	29	44	2 NM	25	1004.8	8.4						
LASH ESPANA	AMERICAN	5	38.3 N	49.2 W	12	23	50	2 NM	16	1006.0	18.4	19.5	10	29.5			
LASH ESPANA	AMERICAN	6	38.4 N	54.2 W	12	31	52	10 NM	62	1017.6	7.2	19.4	6	10	31	9	14.5
PURE OIL	AMERICAN	8	27.9 N	91.3 W	12	34	M 42	5 NM	02	1025.1	8.5	21.1	5	11.5			
SEALAND VENTURE	AMERICAN	9	33.3 N	34.3 W	12	36	M 45	2 NM		1005.8	20.0	18.9	7	18	02	>13	16.5
EAGLE COURIER	AMERICAN	9	34.6 N	32.5 W	06	02	48	1 NM		1009.8	13.4	19.0	XX	19.5			
ERIKA SCHULTE	GERMAN	9	32.9 N	30.8 W	06	27	44	2 NM	65	1006.5	14.8						
SEALAND VENTURE	AMERICAN	10	30.8 N	38.0 W	00	10	M 50	5 NM	02	1010.0	16.7	20.6	7	16.5	36	< 6	18
SALLY MAERSK	LIBERIAN	11	37.2 N	59.3 W	18	29	42	10 NM	03	1021.5	12.0	19.0	8	19.5			
AFRICAN NEPTUNE	AMERICAN	12	39.9 N	65.3 W	18	27	42	5 NM	03	1003.0	10.6	16.9	5	6.5	27	< 6	11.5
INGER	AMERICAN	12	39.6 N	44.8 W	12	30	45	5 NM	80	1020.0	11.7	16.7	3	19.5			
AMER LEADER	AMERICAN	13	45.5 N	43.5 W	18	18	45	1 NM	63	997.0	13.4	16.7	11	36			
M P GRACE	LIBERIAN	13	41.4 N	40.1 W	18	18	45	10 NM	02	1015.0	15.6	17.2	5	11.5			
AMER LEADER	AMERICAN	14	44.0 N	47.4 W	06	35	50	2 NM	07	1011.8	2.8	5.5					
AMER LEGACY	AMERICAN	14	44.4 N	43.3 W	12	34	45	2 NM	07	1005.7	6.7	14.5	3	8	34	12	23
LASH ESPANA	AMERICAN	14	38.9 N	61.5 W	18	22	42	10 NM	02	1012.5	16.7	20.5	7	16.5	20	8	23
M P GRACE	LIBERIAN	14	40.9 N	41.4 W	00	18	35	5 NM	02	1006.0	15.5	17.0	5	11.5	18	6	14.5
M P GRACE	LIBERIAN	16	36.7 N	51.6 W	00	23	41	10 NM	02	1016.0	17.0	17.5	4	13			
ESSO LEXINGTON	AMERICAN	17	34.8 N	74.0 W	18	34	75	< 50 YD	90	992.9	13.5	23.3	3	8			
DELAWARE SUN	AMERICAN	17	34.1 N	72.3 W	00	18	45	5 NM	81	1005.4	21.0	23.8	6	11.5			
EDGAR M QUEENY	AMERICAN	17	25.5 N	85.7 W	19	32	42	10 NM	01	1018.0	17.2	22.2			32	8	14.5
ELIZABETHPORT	AMERICAN	17	40.0 N	54.1 W	18	18	50	5 NM	02	1019.3	16.1	17.8	6	6.5			
SEALAND PRODUCER	AMERICAN	17	33.8 N	67.2 W	00	15	42	10 NM	21	1013.2	17.3	17.3	5	16.5			
EXPORT LEADER	AMERICAN	18	40.3 N	55.6 W	18	21	48	5 NM	02	1012.0	20.0	21.1	9	19.5	19	12	29.5
SEALAND PRODUCER	AMERICAN	18	37.0 N	54.2 W	06	18	45	10 NM	02	1025.4	19.5	17.6	5	16.5			
ROBERT E LEE	AMERICAN	18	40.4 N	58.1 W	12	20	48	2 NM	63	1009.1	15.0	9.4	6	19.5	20	X	65.5
AUSTRAL PATRIOT	AMERICAN	19	35.1 N	60.8 W	18	29	50	5 NM	02	1012.3	18.4	18.9	5	23	22	8	16.5
MOKAMBO	BELGIAN	20	40.9 N	57.7 W	00	04	34	1 NM	63	1003.0	10.2	12.6			05	7	13
AUSTRAL PATRIOT	AMERICAN	20	36.0 N	62.4 W	00	36	45	5 NM	02	1018.6	11.7	17.8	8	24.5			
GULFQUEEN	AMERICAN	22	33.5 N	73.7 W	06	28	50	5 NM	07	1007.8	15.8	21.7			30	X	32.5
ELIZABETHPORT	AMERICAN	23	40.3 N	66.2 W	06	30	50	10 NM	22	995.6	- 2.8	9.0			29	6	14.5
SEALAND GALLOWAY	AMERICAN	27	46.7 N	25.7 W	18	34	48	10 NM	02	1015.1	7.3		3	16.5			
SEALAND GALLOWAY	AMERICAN	28	47.1 N	21.8 W	06	29	45	10 NM	02	1009.0	8.3	12.2	3	11.5			
SEALAND VENTURE	AMERICAN	28	45.7 N	25.0 W	18	25	M 50	5 NM	21	998.3	12.2	12.8	6	10	25	9	13
SEALAND VENTURE	AMERICAN	29	46.8 N	19.4 W	06	30	M 56	10 NM	26	984.4	8.0	12.8			30	12	14.5
AMER LEGACY	AMERICAN	29	45.5 N	25.9 W	12	32	55	5 NM	25	998.2	7.7	14.0	5	13	32	11	36
SEALAND MARKET	AMERICAN	30	47.4 N	17.0 W	12	36	45	10 NM	91	990.2	10.6	9.4	8	8	30	12	19.5
AMER LEGACY	AMERICAN	30	46.1 N	27.3 W	00	32	50	5 NM	18	1006.6	10.0	12.2	6	16.5	32	12	37.5
OCEAN STATION VESSELS																	
ATLANTIC H																	
INGHAM	AMERICAN	18	38.0 N	71.0 W	00	01	M 45	2 NM	61	994.8	6.3	16.3	8	18			
INGHAM	AMERICAN	22	38.0 N	71.0 W	12	30	M 47	5 NM	85	1005.1	2.8	12.6	9	21			
INGHAM	AMERICAN	23	38.0 N	71.0 W	12	31	M 52	.25 NM	86	1015.6	- 1.8	13.2	10	24.5			
GREAT LAKES VESSELS																	
LEON FALK JR	AMERICAN	4	41.7 N	82.5 W	12	27	M 48	2 NM	70		- 9.0	3.0	6	6.5			
G M HUMPHREY	AMERICAN	13	45.5 N	83.4 W	00	17	M 56	10 NM	02		- 3.0	6.0	7	10			
PHILIP R CLARKE	AMERICAN	14	47.1 N	86.1 W	18	29	M 42	2 NM	71		-12.0	6.0	5	8			
NORTH ATLANTIC OCEAN		FEB.															
SEALAND MARKET	AMERICAN	1	46.4 N	44.1 W	18	29	47	10 NM	03	1018.6	0.0	9.5	7	10	29	13	19.5
AMER ACE	AMERICAN	1	45.4 N	36.4 W	12	26	55	2 NM		1003.0	12.8	15.5			26	7	23
AMER LEGACY	AMERICAN	1	43.7 N	48.9 W	00	22	45	2 NM	64	998.5	14.0	11.2	4	13	22	8	18
STAGHOUND	AMERICAN	2	37.4 N	71.1 W	18	28	45	5 NM	02	1007.3	4.5	15.0	4	11.5	27	8	41
SYCVO	NORWEGIAN	2	34.7 N	73.0 W	12	26	37	5 NM	81	1006.0	15.0	22.0	8	32.5			
SAN JUAN	AMERICAN	2	39.9 N	67.9 W	18	24	50	10 NM	02	999.3	14.5	12.0	8	18	24	8	46
SEALAND CONSUMER	AMERICAN	2	40.7 N	32.9 W	12	23	45	10 NM	00	1020.9	12.2	14.5	5	16.5	23	6	32.5
MUMR ONE	LIBERIAN	2	34.8 N	73.0 W	12	27	48	2 NM		1000.4	14.0	20.0	8	23			
SEALAND RESOURCE	AMERICAN	2	39.6 N	31.2 W	18	31	50	10 NM	03	1017.0	10.0	15.6			31	10	29.5
AMER LEGACY	AMERICAN	2	41.5 N	62.6 W	18	20	40	2 NM	18	997.6	13.3	6.7	6	19.5	20	8	41
AMER ACCORD	AMERICAN	2	39.8 N	69.5 W	12	16	85	30 YD	07	980.0	12.2	7.2			16	X	41
DALLAS	AMERICAN	2	43.0 N	67.7 W	18	21	M 44	.25 NM	07	983.0	1.1	4.4	7	29.5			
AMER ACE	AMERICAN	2	45.4 N	37.3 W	00	28	48	5 NM	07	1013.8	6.0	13.5	7	16.5	27	X	49
GUAYAMA	AMERICAN	2	32.1 N	78.9 W	00	23	45	5 NM	01	992.2	17.2	23.3	6	14.5	23	9	19.5
ESSO NEW ORLEANS	AMERICAN	2	40.3 N	69.6 W	13	23	M 70	5 NM	02	977.3	5.6	7.8	8	29.5			
BECLA MAERSK	DANISH	2	43.7 N	28.8 W	18	30	56	2 NM	07	1000.0	12.0				30	9	23
SEALAND MARKET	AMERICAN	3	45.0 N	61.4 W	18	25	64	5 NM	02	1008.5	- 3.0	0.0			25	6	24.5
SEALAND CONSUMER	AMERICAN	3	43.3 N	30.7 W	00	31	50	10 NM	02	1006.2	10.0	15.0	8	23	34	7	65.5
SEALAND RESOURCE	AMERICAN	3	41.7 N	26.6 W	12	34	45	5 NM	02	1004.0	14.4	13.9	4	8	34	10	39
AMER ACCORD	AMERICAN	3	41.2 N	65.1 W	00	25	50	2 NM	07	1005.0	5.6	6.1			25	X	41
PRES HARRISON	AMERICAN	3	36.8 N	24.2 W	12	32	45	10 NM	18	1001.2	13.9	15.6	10	14.5	32	>13	32.5
MARSHFIELD	AMERICAN	3	42.8 N	35.4 W	00	34	41	5 NM	07	1021.0	11.7	14.5			33	X	16.5
ESSO NEW ORLEANS	AMERICAN	3	41.5 N	68.8 W	00	26	M 70	5 NM	02	1005.8	0.8	6.6	8	29.5			
ULTRAMAR	AMERICAN	3	34.4 N	28.6 W	18	34	41	10 NM	15	1013.5	15.0	15.6		13	32	12	29.5

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves+ Period sec.	Sea Waves+ Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH ATLANTIC OCEAN		FEB.															
BELLA MAERSK	DANISH	3	43.5 N	29.7 W	00	32	36	2 NM	07	1003.0	10.0				32	7	23
ZIM HONGKONG	LIBERIAN	3	37.4 N	24.2 W	18	34	42	5 NM	80	999.0	14.0	18.0	3	8	32	7	23
ULTRAMAR	AMERICAN	4	31.0 N	30.5 W	12	34	41	10 NM	15	1020.5	18.2	16.2		13	32	12	29.5
SEALAND VENTURE	AMERICAN	4	44.8 N	29.7 W	18	23	M 45	5 NM	58	1011.2	10.0	12.8	5	6.5	02	6	6.5
LIGHTNING	AMERICAN	5	45.5 N	36.5 W	21	18	42	1 NM	97	997.8	12.0	12.4	5	10	23	7	18
PRES HARRISON	AMERICAN	5	40.4 N	43.0 W	18	21	50	2 NM		997.0	15.0	16.1			21	< 6	14.5
ZIM HONGKONG	LIBERIAN	5	40.5 N	42.8 W	18	22	45	5 NM	61	997.0	12.0	18.0	3	8	24	6	16.5
BELLA MAERSK	DANISH	5	42.5 N	47.0 W	18	27	47	2 NM	07	995.0	4.0		4	13			
STAGHOUND	AMERICAN	5	44.4 N	40.4 W	18	19	42	2 NM	61	989.5	10.0	14.0	3	10	32	10	13
LIGHTNING	AMERICAN	6	44.1 N	40.0 W	18	28	55	10 NM	96	992.9	5.2	12.8	6	14.5	27	10	36
AMER ACCORD	AMERICAN	6	48.9 N	29.1 W	12	21	55	2 NM	60	973.0	9.4	12.2		41			
SEALAND VENTURE	AMERICAN	6	39.6 N	41.2 W	00	22	M 50	2 NM	18	998.0	12.8	16.1	6	19.5			
STAGHOUND	AMERICAN	6	46.5 N	32.2 W	12	25	50	5 NM	93	981.4	8.3	14.0			24	8	19.5
HOEGH DYKE	NORWEGIAN	7	38.7 N	39.2 W	18	22	42	10 NM	02	1009.5	19.0	16.0					
AMER ACCORD	AMERICAN	7	50.6 N	24.2 W	00	23	40	5 NM	03	986.0	7.2	12.8		41			
SEALAND VENTURE	AMERICAN	7	34.8 N	53.4 W	12	24	M 55	10 NM	01	1004.7	18.3	18.9			24	9	18
HOEGH DYKE	NORWEGIAN	8	39.7 N	43.2 W	12	21	50	2 NM	21	1003.5	18.5	16.0					
AMER ACCORD	AMERICAN	8	50.1 N	09.7 W	06	23	20	10 NM	02	1016.3	7.8	11.1	7	16.5	23	7	32.5
SEALAND VENTURE	AMERICAN	8	29.9 N	55.4 W	06	22	M 45	5 NM	01	1007.1	21.1	21.1	5	13			
LASH ESPANA	AMERICAN	10	35.1 N	62.5 W	06	34	45	5 NM	62	1001.4	13.9	18.8	4	8	34	6	14.5
FROSTA	NORWEGIAN	10	28.5 N	60.2 W	06	22	41	10 NM	82	1011.0	20.0	22.0	5	8			
CHEVRON FELUY	LIBERIAN	11	36.3 N	54.0 W	00	27	M 42	10 NM	00	1005.6	16.8	18.3			24	10	24.5
FALSTRIA	DANISH	12	50.0 N	11.0 W	12	27	M 45	2 NM		1001.4	13.8		6	16.5			
LIGHTNING	AMERICAN	15	43.5 N	42.0 W	12	18	45	2 NM	41	1002.0	16.7	16.9	6	8	18	9	11.5
JOSEPH D POTTS	AMERICAN	16	33.4 N	39.7 W	00	30	45	5 NM	65	1012.8	17.3	14.5					
STAGHOUND	AMERICAN	16	43.1 N	31.3 W	18	32	41	5 NM	02	1011.9	9.0	15.0	4	10	24	8	19.5
JOSEPH D POTTS	AMERICAN	17	37.0 N	40.6 W	12	25	45	5 NM	02	1017.1	17.2	15.0	5	10	25	10	16.5
SANTA CRUZ	AMERICAN	17	37.2 N	74.8 W	12	30	M 43	2 NM	10	1011.1	12.3	3.8	4	13	05	< 6	16.5
JOSEPH D POTTS	AMERICAN	18	37.1 N	49.3 W	12	24	50	2 NM		1000.4	18.9	19.4	6	11.5	25	13	32.5
STAGHOUND	AMERICAN	18	42.0 N	48.0 W	18	36	47	5 NM	02	1011.2	4.4	13.4	3	10	35	7	26
SEALIFT CHINA SEA	AMERICAN	19	43.1 N	21.0 W	18	18	48	2 NM		989.0	13.5	13.0	4	18	18	10	19.5
ROW ELM	NORWEGIAN	19	42.0 N	33.7 W	12	32	41	5 NM	81	1006.0	8.0				30	7	19.5
AMER ACCORD	AMERICAN	19	47.8 N	20.8 W	18	20	50	2 NM	22	983.0	9.4	11.1			22	>13	24.5
PRES EISENHOWER	AMERICAN	19	40.2 N	41.0 W	00	36	45	5 NM	02	1002.0	10.0	16.1					
EXPORT FREEDOM	AMERICAN	20	42.7 N	43.6 W	18	27	45	5 NM	07	1003.0	10.0	16.2	6	8	30	6	24.5
AMER ARGOSY	AMERICAN	20	42.3 N	44.2 W	06	26	47	.25 NM	81	994.2	13.9	16.7					
ADM W M CALLAGHAN	AMERICAN	20	40.5 N	40.2 W	12	21	45	2 NM	05	1002.0	17.8	16.3	6	13			
AMER ACCORD	AMERICAN	20	46.7 N	28.4 W	18	20	55	2 NM	25	984.0	10.0	12.8	6	19.5			
PRES EISENHOWER	AMERICAN	20	40.3 N	48.1 W	00	20	45	5 NM	02	1005.0	16.7	17.8			21	8	18
AMER ACCORD	AMERICAN	21	46.7 N	29.8 W	00	25	55	2 NM	60	985.0	10.0	10.6		24.5			
BERGLJOT	NORWEGIAN	21	42.0 N	45.9 W	18	31	M 50	2 NM	15	1007.5	7.0	16.0	8	19.5			
OAKLAND	AMERICAN	22	34.3 N	73.9 W	18	21	50	2 NM		1011.2	20.5	21.6	2	10	21	7	13
AMER ACCORD	AMERICAN	22	45.2 N	39.0 W	06	32	42	5 NM	81	1005.0	4.4	13.9					
BERGLJOT	NORWEGIAN	22	44.0 N	42.3 W	12	32	M 47	10 NM	16	1024.0	2.0	15.0	6	11.5	32	8	23
SEALAND MARKET	AMERICAN	23	38.1 N	61.9 W	06	20	34	10 NM	02	1008.5	19.5	17.8			20	X	13
BERGLJOT	NORWEGIAN	23	48.5 N	36.0 W	18	21	M 47	1 NM	50	1018.0	11.5	9.5	2	10	21	6	16.5
AMER LEGEND	AMERICAN	23	38.5 N	68.8 W	00	22	45	1 NM	64	1001.0	14.0	14.4	4	6.5	23	9	10
AMER ACCORD	AMERICAN	23	43.0 N	51.7 W	18	20	47	2 NM	25	1003.0	12.2	7.2	10	32.5			
BERGLJOT	NORWEGIAN	24	52.2 N	29.8 W	18	21	M 52	2 NM		1013.0	11.0	7.0	6	13	21	X	26
MOBIL GAS	AMERICAN	25	24.6 N	83.5 W	00	04	43	5 NM	80	1023.4	17.2	24.6	7	10	07	9	14.5
BERGLJOT	NORWEGIAN	25	53.1 N	28.0 W	00	21	M 43	2 NM		1011.0	11.0	7.0					
AMER LEGACY	AMERICAN	27	43.5 N	39.2 W	18	34	50	5 NM	18	1016.0	14.0	13.4	6	11.5	34	8	14.5
LIGHTNING	AMERICAN	27	44.3 N	44.8 W	00	34	45	5 NM	18	1022.6	2.7	13.5	6	13			
FROSTFJORD	NORWEGIAN	28	36.6 N	29.4 W	18	31	M 44	10 NM	03	1013.0	15.5						
LIGHTNING	AMERICAN	29	41.3 N	64.7 W	00	27	50	10 NM	01	1003.0	8.9	5.6	5	11.5			
OCEAN STATION VESSELS																	
ATLANTIC H																	
INGHAM	AMERICAN	2	38.0 N	71.0 W	12	26	M 70	1 NM	07	991.2	9.0	14.2	9	28			
GREAT LAKES VESSELS																	
LEON FRASER	AMERICAN	1	45.5 N	86.6 W	12	34	M 55	2 NM	70		-10.0	3.0	3	8			
ARTHUR M ANDERSON	AMERICAN	8	47.6 N	90.5 W	06	33	M 46	10 NM	01		- 4.0	2.0	9	10			

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kn or waves ≥ 25 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

Table 12

Selected Gale and Wave Observations, North Pacific

January and February 1976

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves Period sec.	Sea Waves Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH PACIFIC OCEAN		JAN.															
LONG BEACH	PANAMANIAN	1	34.2 N	155.2 E	00	31	M 48	5 NM	18	1011.0	9.0	13.0	8	24.5			
SEALAND FINANCE	AMERICAN	1	35.1 N	174.3 W	00	19	45	5 NM	62	1000.3	16.8	14.2	6	6.5	19	9	14.5
MONTANA	AMERICAN	3	33.8 N	155.8 E	06	29	48	10 NM	01	1012.2	13.9	17.2	6	16.5	32	8	28
BECHUDSON	BRITISH	4	44.1 N	149.0 W	12	26	M 45	10 NM	15	1015.1	10.4	9.0	4	6.5	30	12	19.5
VAN CONQUEROR	LIBERIAN	4	48.6 N	148.9 W	00	27	M 50	5 NM	02	1003.0	6.0	6.0					
VAN FORT	LIBERIAN	4	48.6 N	173.2 E	12	22	M 45	2 NM		980.0	5.0	4.0					
BECHUDSON	BRITISH	5	44.8 N	144.8 W	00	27	M 45	10 NM	15	1016.7	8.9	8.5	4	8	27	12	24.5
VANGUARD	LIBERIAN	5	38.5 N	158.2 W	00	09	M 43	2 NM	81	1011.0	12.0	15.0					
VAN FORT	LIBERIAN	5	48.2 N	171.6 E	00	27	M 47	5 NM	70	996.0	4.0	4.0					
EASTERN BUILDER	LIBERIAN	6	35.8 N	161.4 E	00	22	M 45	2 NM		1006.0	19.0	19.0	10	14.5	21	13	21
PORTLAND	AMERICAN	7	56.3 N	143.8 W	18	09	48	2 NM	58	999.0	1.7	4.4	5	8	09	8	14.5
BRIDGE	BRITISH	7	37.9 N	157.4 E	06	27	45	5 NM	90	996.5	8.8	16.2	10	23			
EASTERN BUILDER	LIBERIAN	7	36.0 N	155.3 E	12	29	48	10 NM	02	1010.5	12.0	17.0	9	13	30	12	19.5
GRAND CARRIER	LIBERIAN	7	36.1 N	176.6 E	18	18	M 45	5 NM	05	1014.0	17.0	13.0			18	6	13
VAN CONQUEROR	LIBERIAN	8	47.7 N	179.2 E	00	22	M 42	2 NM		987.0	5.0	6.0					
BRIDGE	BRITISH	8	38.7 N	154.8 E	00	28	45	10 NM	02	1013.0	11.2	15.6	9	23			
HONSHU MARU	JAPANESE	8	50.6 N	176.3 E	06	24	M 44	.5 NM	65	975.0	3.0	3.0	10	13	24	11	16.5
BRIDGE	BRITISH	9	40.6 N	148.1 E	06	29	49	10 NM	65	997.6	5.0	13.5	3	6.5			
CRESSIDA	PANAMANIAN	10	52.4 N	165.3 W	12	32	M 45	5 NM	03	1003.0	- 1.0	0.0	6	19.5			
GRAND CARRIER	LIBERIAN	10	34.7 N	157.8 E	18	25	M 45	10 NM	02	1010.0	14.0	17.0	9	19.5			
CRESSIDA	PANAMANIAN	11	51.4 N	176.1 W	18	11	M 42	5 NM	02	994.0	4.0	3.6	6	19.5			
ZIM NEW YORK	GERMAN	11	38.9 N	158.9 E	06	27	45	1 NM	81	1000.4	8.2	12.2	XX	13			
VAN CONQUEROR	LIBERIAN	11	44.3 N	162.4 E	00	28	M 42	5 NM	85	996.0	1.5	5.0					
HONSHU MARU	JAPANESE	11	47.9 N	159.0 E	18	22	M 42	2 NM		980.5	0.0	1.0	10	14.5	25	12	21
PRES JEFFERSON	AMERICAN	12	41.7 N	176.6 W	06	26	45	5 NM	02	1004.4	9.4	10.0	6	14.5	20	9	6.5
GRAND CARRIER	LIBERIAN	12	33.7 N	148.9 E	06	29	M 55	5 NM	18	1001.5	11.0	17.0					
EATON GLORIA	LIBERIAN	12	32.0 N	146.2 E	06	26	M 48	10 NM	97	1008.0	11.0	18.0	5	29.5	30	8	23
ROSE	LIBERIAN	13	34.3 N	120.5 W	00	33	M 43	10 NM	00	1017.3	13.5	12.0					
ASIA BOTAN	LIBERIAN	13	38.5 N	172.2 E	00	23	M 48	2 NM		998.0	15.0	17.0	11	16.5	23	13	21
VAN CONQUEROR	LIBERIAN	13	39.7 N	151.5 E	06	27	M 45	5 NM	02	1009.0	5.0	4.0					
ASIA BOTAN	LIBERIAN	15	39.4 N	173.4 W	00	29	M 43	5 NM	50	1001.3	9.6	13.0			31	>13	16.5
SEALAND COMMERCE	AMERICAN	16	34.8 N	172.2 E	03	22	50	5 NM	62	993.0	18.5	14.5	7	29.5	32	10	10
THOMAS JEFFERSON	AMERICAN	16	31.2 N	142.7 W	05	18	45	10 NM	02	1016.5	19.5	21.0	6	10			
PACDUKE	LIBERIAN	17	41.3 N	178.9 E	00	29	M 42	10 NM	03	991.5	6.0	12.0	5	13	29	>13	32.5
PRES PIERCE	AMERICAN	18	33.9 N	157.0 E	12	23	45	5 NM	02	996.6	16.1	14.4	5	14.5	20	< 6	16.5
SEALAND FINANCE	AMERICAN	18	40.5 N	166.8 E	18	16	45	10 NM	02	998.0	9.4	11.7	5	10	17	9	14.5
BRIDGE	BRITISH	18	33.8 N	139.9 E	12	27	48	10 NM	00	1007.8	9.3	17.8	5	10	27	9	13
SEALAND FINANCE	AMERICAN	19	41.0 N	167.9 E	00	18	50	2 NM	62	997.6	12.3	11.7	7	10	18	9	16.5
PACIFIC WING	PANAMANIAN	21	30.5 N	151.9 E	12	25	M 45	5 NM	07	1009.5	16.0	14.0	XX	16.5	25	>13	24.5
SINCLAIR TEXAS	AMERICAN	21	54.4 N	140.7 W	18	21	50	5 NM	02	1001.5	5.6	3.8	10	41			
PHILADELPHIA	AMERICAN	21	55.2 N	140.2 W	12	20	48	5 NM	02	990.8	3.0	5.5	6	24.5			
PACSTAR	LIBERIAN	21	54.0 N	158.0 W	00	33	43	5 NM	01	990.0	- 1.0	2.0			33	8	16.5
PORTLAND	AMERICAN	21	57.7 N	146.9 W	18	23	41	2 NM	71	981.4	2.8	4.4	6	10	23	7	13
RUSH	AMERICAN	21	54.6 N	160.3 W	06	30	M 45	.5 NM	71	991.3	- 9.5	- 0.5	5	14.5	06	< 6	5
THOMAS JEFFERSON	AMERICAN	21	14.0 N	98.3 W	18	06	45	10 NM	03	1012.3	23.5	27.0	6	11.5			
VAN ENTERPRISE	LIBERIAN	21	50.4 N	177.0 W	18	10	M 48	2 NM	83	1004.0	0.0	2.0	6	11.5			
SINCLAIR TEXAS	AMERICAN	22	50.2 N	134.9 W	18	25	50	5 NM	82	1016.3	3.3	3.9	6	13	25	X	19.5
PACSTAR	LIBERIAN	22	54.1 N	163.5 W	00	31	47	5 NM	01	1000.0	- 8.0	2.0			31	10	19.5
POLAR ALASKA	LIBERIAN	22	43.2 N	155.6 E	06	29	M 50	2 NM	87	991.5	- 2.0	5.0	10	13			
BRIDGE	BRITISH	22	13.2 N	131.4 E	06	05	46	5 NM	16	1010.0	25.8	28.3	3	8			
THOMAS JEFFERSON	AMERICAN	22	13.1 N	96.7 W	00	06	55	5 NM	03	1011.0	22.5	27.0	7	11.5			
TRANSCOLORADO	AMERICAN	22	12.9 N	125.3 E	12	06	42	5 NM	02	1012.2	25.6	27.2	6	11.5	05	X	28
BREWSTER	PANAMANIAN	22	47.6 N	178.3 W	18	09	M 50	5 NM	05	968.3	5.0	5.0	5	10	09	< 6	13
KYOJU MARU	JAPANESE	23	54.1 N	167.9 W	18	10	M 42	10 NM	02	987.0	1.0	1.5					
NORBROTT	NORWEGIAN	23	28.8 N	162.3 E	06	24	44	5 NM	02	1006.0	19.5	22.0	6	19.5	27	6	19.5
GOLDEN ANNE	BRITISH	23	30.6 N	154.3 E	06	28	45	5 NM	15	1006.2	16.5	20.0	8	11.5	27	>13	29.5
WASHINGTON	AMERICAN	23	29.3 N	157.2 E	00	26	M 44	10 NM	02	1006.0	19.0	19.4	5	10	27	9	18
NORGESTAD	NORWEGIAN	23	32.1 N	147.5 E	00	30	45	5 NM	02	1009.0	11.5	18.0		19.5			
PACSTAR	LIBERIAN	23	53.8 N	178.8 W	18	09	41	1 NM	72	985.0	0.0	3.0	7	14.5	33	8	16.5
RUSH	AMERICAN	23	52.8 N	168.8 W	09	08	M 41	2 NM	68	996.3	- 0.3	4.7	4	6.5	28	6	6.5
NORBROTT	NORWEGIAN	24	29.0 N	159.6 E	06	27	45	10 NM	25	1003.0	19.0	20.0	7	23	27	7	26
EATON GLORIA	LIBERIAN	24	34.8 N	150.7 E	00	29	M 44	1 NM	77	1006.0	7.0	17.0	10	13	29	>13	16.5
PACIFIC WING	PANAMANIAN	24	33.7 N	145.0 E	00	32	M 47	5 NM	03	1013.5	6.5	17.0	XX	16.5	32	>13	19.5
PLUVIUS	GERMAN	24	34.7 N	151.6 E	00	31	44	5 NM	27	1005.1	6.9	16.3			31	9	16.5
PLUTOS	GERMAN	24	30.2 N	163.4 E	18	30	42	10 NM	15	1002.0	16.5		7	10	29	9	23
PRES VAN BUREN	AMERICAN	24	35.1 N	151.1 E	00	30	50	5 NM	27	1005.2	6.1	16.7	10	24.5			
AMER CORSAIR	AMERICAN	24	31.8 N	168.6 E	12	32	45	5 NM	01	1001.5	13.3	18.3	6	24.5			
GOLDEN ANNE	BRITISH	24	31.1 N	151.1 E	00	30	48	5 NM	02	1009.1	14.0	17.0	6	11.5	29	12	24.5
GOLDENROD	LIBERIAN	24	33.0 N	159.1 E	12	31	M 45	5 NM	13	1002.0	13.0	18.0	8	23			
WASHINGTON	AMERICAN	24	28.4 N	150.4 E	00	29	M 42	10 NM	01	1010.5	16.5	20.6	5	10	29	7	18
UNIVERSE CONVEYOR	LIBERIAN	24	27.5 N	151.3 E	06	30	48	10 NM	02	1009.5	18.2	21.2	5	10	30	10	23
PLUTOS	GERMAN	25	30.2 N	163.2 E	00	31	41	10 NM	15	1005.5	14.8	17.1	7	10	30	8	23
PRES VAN BUREN	AMERICAN	25	35.0 N	163.1 E	06	34	41	10 NM	02	999.3	8.9	15.0	10	16.5			
NORBROTT	NORWEGIAN	25	29.0 N	157.3 E	06	32	41	10 NM	25	1014.0	15.0	20.0	7	23	32	7	26
HONGKONG MAIL	AMERICAN	25	32.3 N	161.1 E	00	30	50	5 NM	82	1005.8	11.7	17.8	6	13	29	7	23
JAG DEV	INDIAN	25	27.8 N	171.2 E	00	23	M 45	2 NM	07	1002.3	22.0						
KINYO MARU	JAPANESE	25	33.0 N	169.1 W	09	27	M 42	2 NM	63	992.0	17.0	18.0	9	13	24	8	10
HONGKONG MAIL	AMERICAN	26	33.6 N	154.5 E	12	33	50	5 NM	82	1007.8	12.2	15.0					
MATHILDE MAERSK	DANISH	26	32.8 N	154.8 E	00	27	41	2 NM	65	1011.0	13.3		4	8	34	12	10
NORBROTT	NORWEGIAN	26	29.6 N	150.6 E	18	32	41	5 NM	25	1014.0	14.0	19.0	7	19.5	32	7	23
SEALAND EXCHANGE	AMERICAN	26	47.9 N	140.4 W	00	21	45	10 NM	03	997.3	8.5	6.1	5	18	18	10	19.5
VAN CONQUEROR	LIBERIAN	26	37.6 N	145.5 E	00	28	M 42	10 NM	01	1010.0	4.0	12.0					
ZIM NEW YORK	GERMAN	26	37.9 N	151.3 E	06	29	48	1 NM	88	999.8	2.5	14.4	8	24.5			
ASIA BRIGHTNESS	LIBERIAN	26	39.6 N	169.5 E	21	26	50	5 NM	96	979.0	7.0	13.0	8	11.5			
CHEVRON MISSISSIPPI	AMERICAN	26	52.1 N	133.0 W	00	14	42	.5 NM	63	999.8	6.4	6.7	2	6.5	20	X	11.5
PHILADELPHIA	AMERICAN	27	56.2 N	143.0 W	12	24	45	2 NM	50	977.0	4.4	5.3	6	19.5			
PRES TAFT	AMERICAN	27	34.9 N	156.0 E	00	29	45	5 NM	99	1004.2	7.8	12.8	7	14.5			
PRES VAN BUREN	AMERICAN	27	39.2 N	176.7 W	06	20	45	5 NM	01	987.5	12.2	12.2					
PORTLAND	AMERICAN	27	53.8 N	137.6 W	18	25	43	10 NM	03	1002.4	4.4	5.6	6	10	25	13	13

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves Period sec.	Sea Waves Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH PACIFIC OCEAN		JAN.															
TAIWAN PHOENIX	SINGAPORE	27	38.7 N	150.5 E	18	33	M 43	.25 NM	80	1009.9	3.0		9	13			
VAN CONQUEROR	LIBERIAN	27	40.7 N	155.4 E	18	32	M 56	2 NM	83	993.0	1.0	7.0					
SEALAND EXCHANGE	AMERICAN	27	52.1 N	152.9 W	00	28	45	10 NM	07	975.2	3.8	3.3	9	23			
ASIA BRIGHTNESS	LIBERIAN	27	40.2 N	172.2 E	06	27	60	1 NM	90	979.0	4.0	13.0	9	41			
EATON GLORIA	LIBERIAN	27	35.7 N	171.0 E	06	28	M 42	5 NM	03	999.0	13.0	16.0	6	19.5			
MATHILDE MAERSK	DANISH	27	33.5 N	162.3 E	00	27	50	> 25 NM	01	1006.0	13.8		7	16.5			
ALBERT MAERSK	DANISH	28	33.1 N	140.1 W	00	20	45	5 NM	02	1015.0	18.0	16.0	8	11.5	20	12	16.5
VAN CONQUEROR	LIBERIAN	28	41.6 N	158.3 E	00	31	M 45	5 NM	85	997.0	2.0	6.0					
TAIWAN PHOENIX	SINGAPORE	28	40.3 N	157.7 E	17	34	M 45	5 NM	01	1012.5	5.0	10.5	9	16.5			
MATHILDE MAERSK	DANISH	28	31.2 N	167.9 E	00	26	41	5 NM	02	1004.5	15.8		6	13			
PRES VAN BUREN	AMERICAN	28	40.7 N	168.5 W	00	24	45	5 NM	02	990.0	13.3	8.9	7	13			
UNIVERSE KURE	LIBERIAN	29	29.4 N	174.0 E	00	32	M 50	10 NM	02	1009.0	15.5	19.0	4	13	32	6	19.5
LIONS GATE BRIDGE	JAPANESE	29	49.8 N	150.5 W	18	16	M 42	.5 NM		974.7	8.5	6.0	7	11.5			
PRES VAN BUREN	AMERICAN	29	42.0 N	149.6 W	18	18	50	2 NM	51	992.2	12.8	8.9			18	9	23
ASIA BRAVERY	LIBERIAN	30	36.4 N	152.9 E	00	22	M 41	5 NM	91	1008.0	15.0	21.0	3	6.5	22	10	18
GOLDEN ARROW	JAPANESE	30	52.9 N	150.0 W	06	23	M 48	.5 NM		984.0	3.5	3.0	5	13	21	9	16.5
FERNGROVE	NORWEGIAN	30	35.5 N	147.7 W	06	18	45	5 NM	03	1013.2	18.0		10	16.5	29	13	6.5
SKOGSTAD	NORWEGIAN	30	53.5 N	154.0 W	03	27	42	2 NM	58	963.8	2.8	2.0					
PACIFIC WING	PANAMANIAN	30	37.3 N	162.5 E	12	22	M 43	2 NM	60	1004.0	14.0	14.0	7	11.5	22	>13	18
PRES VAN BUREN	AMERICAN	30	41.7 N	145.8 W	06	18	45	2 NM	51	1005.1	13.3	8.3					
SEALAND EXCHANGE	AMERICAN	31	43.6 N	151.9 E	06	29	50	5 NM	85	1000.8	- 2.5	0.5	8	24.5	23	8	8
SEISHU MARU	JAPANESE	31	45.1 N	172.1 W	18	16	M 42	.5 NM	63	986.5	4.5	7.0	4	11.5			
ASIA BRAVERY	LIBERIAN	31	39.0 N	164.7 E	18	28	M 50	2 NM		1006.5	8.0	16.0	3	8	28	8	24.5
PRES JEFFERSON	AMERICAN	31	46.4 N	155.7 E	06	26	45	10 NM	26	989.4	- 4.1	0.0	6	13			
NORTH PACIFIC OCEAN		FEB.															
VAN CONQUEROR	LIBERIAN	1	48.3 N	167.2 W	06	13	M 45	1 NM	83	988.0	3.0	5.0					
CRESSIDA	PANAMANIAN	1	36.9 N	144.0 E	18	36	M 45	5 NM	03	1006.0	9.0	12.0	4	6.5	36	8	8
ASIA BRAVERY	LIBERIAN	1	39.5 N	170.7 E	18	31	M 52	5 NM	70	1011.5	7.0	13.0			31	>13	21
FERNGROVE	NORWEGIAN	3	34.4 N	169.6 W	00	33	45	10 NM	16	1006.1	8.0		10	16.5			
LIECHTENSTEIN	LIBERIAN	3	32.3 N	161.6 W	12	28	45	2 NM		1004.0	15.0	17.8	9	14.5			
POCAR ALASKA	LIBERIAN	3	49.6 N	158.0 E	06	11	M 54	2 NM	87	998.0	- 1.0	0.0	12	16.5			
HOEGH OPAL	NORWEGIAN	4	30.0 N	178.0 W	21	07	45	2 NM	60	998.0	15.0	16.0	9	16.5			
TRANSONEIDA	AMERICAN	5	24.2 N	169.5 W	00	22	50	5 NM	60	994.9	23.3	24.4	9	32.5			
SEALAND EXCHANGE	AMERICAN	5	29.4 N	128.0 E	06	32	45	5 NM	02	1014.0	9.8	21.7	12	23			
HOEGH OPAL	NORWEGIAN	5	29.7 N	178.9 W	00	06	45	1 NM	64	1000.0	15.0	16.0	8	23			
FEDERAL NAGARA	LIBERIAN	5	29.9 N	167.2 W	12	03	M 47	.25 NM	81	986.7	14.4	13.0			03	12	18
HONGKONG CONTAINER	LIBERIAN	5	36.5 N	153.6 E	18	17	M 44	2 NM	62	996.5	15.0	16.0					
FERNDALE	NORWEGIAN	5	34.3 N	145.5 E	12	21	45	2 NM	80	994.0	17.5	18.0	8	13			
GOLDEN GATE	AMERICAN	5	34.9 N	163.6 W	18	07	45	5 NM	02	1000.0	13.4	11.2	5	10	07	8	18
OYVI OCEANIC	NORWEGIAN	5	38.4 N	127.1 W	12	01	44	5 NM	01	1013.0	8.0	12.0	9	10	36	7	19.5
SAN BRUNO	SWEDISH	5	26.2 N	161.4 W	18	21	45	5 NM	03	997.0	23.8		4	11.5	21	8	16.5
PACIFIC ARROW	JAPANESE	5	32.0 N	170.0 W	12	03	M 42	5 NM	02	1000.0	12.0		5	10			
OGDEN JORDAN	LIBERIAN	5	25.6 N	178.1 W	06	32	M 45	5 NM	16	993.0	19.0	20.0	6	16.5			
PRES PIERCE	AMERICAN	6	36.1 N	150.2 E	06	29	47	2 NM		985.4	9.4	11.7			29	8	24.5
ALASKAN MAIL	AMERICAN	6	38.1 N	157.9 E	06	19	50	2 NM	61	985.1	12.8	12.2			19	10	21
WICYAMA	ITALIAN	6	20.4 N	162.4 W	06	18	41	5 NM	80	1008.0	25.0	25.0	7	10			
FERNGROVE	NORWEGIAN	6	33.9 N	168.3 E	12	17	45	5 NM	18	1005.8	15.5						
FERNDALE	NORWEGIAN	6	34.3 N	151.3 E	06	27	48	10 NM	01	993.0	12.0	18.0	12	19.5			
HONGKONG CONTAINER	LIBERIAN	6	37.1 N	159.5 E	06	18	M 45	2 NM	62	990.5	14.5	14.0	6	18	17	8	23
FEDERAL NAGARA	LIBERIAN	6	29.5 N	166.0 W	00	36	M 49	200 YD	81	995.0	14.2	14.0			36	13	19.5
ALASKAN MAIL	AMERICAN	7	38.5 N	161.8 E	00	25	65	5 NM	81	984.0	10.0	13.4			25	>13	39
HERMINA	LIBERIAN	7	33.0 N	163.3 W	00	34	45	2 NM	62	1007.0	15.0	15.0	6	21	33	>13	24.5
SEALAND FINANCE	AMERICAN	7	45.0 N	152.6 E	00	34	45	2 NM	26	986.8	0.0	0.5			34	8	11.5
COLORADO	AMERICAN	7	49.5 N	165.7 E	12	09	50	.25 NM	73	963.2	5.5	1.1	5	13	09	8	19.5
AH JIN	KOREAN	7	43.1 N	171.0 E	00	18	M 42	5 NM	51	982.0	10.5	11.5			18	12	19.5
PHILADELPHIA	AMERICAN	8	38.8 N	150.2 W	18	30	50	1 NM	72	985.0	-10.0	3.3	6	19.5			
LIONS GATE BRIDGE	JAPANESE	8	50.8 N	138.9 W	18	27	M 46	2 NM		1006.0	6.5	7.5	8	19.5			
GOLDEN RAY	LIBERIAN	8	38.8 N	173.4 E	00	16	M 42	.25 NM		990.0	14.0	13.0	4	8	16	11	6.5
NEWARK	AMERICAN	8	54.3 N	138.4 W	12	33	52	5 NM	70	986.3	0.0	5.6	7	16.5	33	10	21
SANTA CLARA	AMERICAN	8	48.8 N	134.0 W	06	23	45	10 NM	02	991.2	8.8	8.8	2	6.5	23	6	23
VAN PORT	LIBERIAN	8	49.5 N	129.9 W	06	16	M 45	5 NM	07	996.0	7.5	6.0					
BECHAR	NORWEGIAN	8	53.3 N	173.5 E	00	09	50	2 NM	83	988.0	2.0	1.0	11	23			
PHILADELPHIA	AMERICAN	9	58.0 N	147.2 W	00	28	42	.5 NM	73	986.1	- 5.6	5.5	6	19.5			
NEWARK	AMERICAN	9	55.1 N	139.6 W	00	27	52	5 NM	88	990.7	- 0.6	6.1	7	19.5	27	12	36
LIONS GATE BRIDGE	JAPANESE	9	51.3 N	140.7 W	00	26	M 41	5 NM	02	1004.6	6.0	7.0	7	14.5	26	12	16.5
VAN ENTERPRISE	LIBERIAN	9	41.6 N	163.2 E	18	28	M 42	5 NM	70	994.0	3.0	7.0	7	11.5	28	8	16.5
COLORADO	AMERICAN	9	51.4 N	159.5 E	12	03	50	.5 NM	73	987.2	2.2	0.0	5	14.5	03	13	19.5
VAN ENTERPRISE	LIBERIAN	10	41.8 N	165.5 E	00	26	M 42	5 NM	02	996.0	4.0	5.0	7	11.5	26	8	16.5
COLORADO	AMERICAN	10	51.6 N	159.9 E	00	03	43	.5 NM	72	999.4	1.1	0.6	8	14.5	03	10	19.5
LIECHTENSTEIN	LIBERIAN	11	32.3 N	156.1 E	18	25	M 43	2 NM		1013.5	14.0	17.2	8	14.5			
BECHAR	NORWEGIAN	12	38.2 N	140.1 E	06	33	55	200 YD	86	1013.0	0.5	6.0	8	26			
UNIVERSE KURE	LIBERIAN	12	31.9 N	151.6 E	18	29	M 55	5 NM	27	1007.0	6.0	17.5	5	14.5	32	9	19.5
LIECHTENSTEIN	LIBERIAN	12	32.2 N	153.3 E	12	27	M 60	5 NM	02	1006.0	10.0	16.2	9	29.5			
PACIFIC GLORY	PANAMANIAN	13	31.6 N	160.2 E	06	31	M 42	5 NM	01	1003.0	13.0	11.0	6	10	31	8	13
UNIVERSE KURE	LIBERIAN	13	31.6 N	153.2 E	00	32	M 50	10 NM	02	1009.0	10.0	17.5	5	14.5	32	9	21
WICYAMA	ITALIAN	13	27.7 N	161.2 E	12	27	M 45	> 25 NM	02	1011.0	16.0	23.0	7	19.5			
HERMINA	LIBERIAN	13	33.1 N	164.3 E	18	29	44	5 NM	25	1000.2	12.0	16.0	6	19.5	28	9	26
SPERO	NORWEGIAN	14	34.1 N	175.8 E	06	26	44	5 NM	03	1001.0	15.0	14.0			26	X	14.5
HERMINA	LIBERIAN	14	33.1 N	163.6 E	00	29	45	5 NM	03	1000.7	13.0	16.0	6	19.5	28	9	32.5
UTAH STANDARD	AMERICAN	16	42.9 N	125.0 W	05	18	45	5 NM	51	1015.5	9.5	8.9	5	16.5			
VAN ENTERPRISE	LIBERIAN	16	49.4 N	138.7 W	12	27	M 42	5 NM	01	1003.0	7.0	5.0	8	13			
OYVI OCEANIC	NORWEGIAN	17	51.2 N	168.2 E	06	26	44	2 NM	26	1000.1	- 4.0	2.0			26	X	39
VAN ENTERPRISE	LIBERIAN	17	47.7 N	128.5 W	18	23	M 46	2 NM		997.0	10.0	7.0	8	13			
HERMINA	LIBERIAN	17	34.6 N	149.2 E	06	30	30	2 NM	40	1018.0	23.0	17.0	3	23	22	7	36
GOLDEN ARROW	JAPANESE	17	47.3 N	171.0 W	12	28	M 50	.5 NM	30	1005.5	2.0	4.0	6	10	28	8	19.5
OYVI OCEANIC	NORWEGIAN	18	49.6 N	163.2 E	06	30	37	5 NM	26	1001.4	- 3.0	2.0	10	29.5	33	X	32.5
VAN PORT	LIBERIAN	18	50.5 N	168.5 W	20	22	M 50	1 NM	63	980.0	5.0	3.0			22	10	57
VAN ENTERPRISE	LIBERIAN	18	47.3 N	126.5 W	00	23	M 45	2 NM	70	999.0	9.0	6.0	9	14.5	23	10	19.5
SINCLAIR TEXAS	AMERICAN	18	49.9 N	128.0 W	00	23	42	5 NM	15	983.4	6.6	5.6	3	10	20	12	14.5
VAN PORT	LIBERIAN	19	50.2 N	168.6 W	00	25	M 59	2 NM	63	985.0	3.0	3.0					
GOLDENWOOD	LIBERIAN	19	43.9 N	137.2 W	00	32	M 58	2 NM		1014.5	9.0	10.0	9	19.5			
ROBERTS BANK	LIBERIAN	19	48.5 N	162.6 E	12	14	45	5 NM	26	993.9	1.0		4	6.5	13	12	16.5
POCAR ALASKA	LIBERIAN	19	54.2 N	169.7 W	18	35	M 47	2 NM	22	1020.0	- 3.2	1.0	16	21			
ASIA BRIGHTNESS	LIBERIAN	20	44.6 N	153.0 E	09	27	45	1 NM	86	1017.0	- 5.0	2.0	5	14.5			
POCAR ALASKA	LIBERIAN	20	53.5 N	172.6 W	00	35	M 47	2 NM	99	1026.0	- 3.6	1.0	10	8			
ROBERTS BANK	LIBERIAN	20	47.3 N	159.7 E	18	29	50	5 NM	26	1012.0	- 4.0				30	12	19.5
CRESSIDA	PANAMANIAN	21	51.8 N	140.8 W	18	32	M 41	5 NM	60	992.0	3.0	5.0	7	16.5			
SEALAND COMMERCE	AMERICAN	21	33.1 N	153.9 E	18	06	45	2 NM	07	1012.3	13.0	13.5	6	19.5			

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves+ Period sec.	Sea Waves+ Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH PACIFIC OCEAN		FEB.															
ROBERTS BANK	LIBERIAN	21	47.0 N	158.6 E	00	28	44	10 NM	26	1020.1	- 5.0		4	8	30	12	19.5
PRES JEFFERSON	AMERICAN	21	36.3 N	161.5 E	12	02	45	5 NM	63	1022.0	10.0	11.1	4	10			
PORTLAND	AMERICAN	21	53.5 N	135.9 W	18	14	59	5 NM	02	989.5	5.6	6.7	5	10	16	12	13
POLAR ALASKA	LIBERIAN	21	55.0 N	170.9 E	18	27	M 45	1 NM	83	1010.0	- 2.1	1.0	12	10			
CRESSIDA	PANAMANIAN	22	52.3 N	147.4 W	18	25	M 42	5 NM	01	994.0	2.0	3.7	7	23			
PACKING	LIBERIAN	22	52.8 N	159.7 W	00	27	M 60	10 NM	07	1000.1	4.0	5.0			29	>13	11.5
POLAR ALASKA	LIBERIAN	22	52.7 N	169.5 E	00	27	M 47	2 NM	83	1013.0	- 3.2	1.0	14	10			
PHILADELPHIA	AMERICAN	22	53.5 N	139.2 W	00	33	42	5 NM	26	989.0	3.2	5.5	5	14.5	02	7	18
PRES JEFFERSON	AMERICAN	22	37.6 N	166.7 E	00	08	47	2 NM	61	1021.0	9.4	11.7	4	10			
EXPORT COURIER	AMERICAN	23	14.3 N	95.0 W	06	02	38	5 NM	02	1016.0	19.4	19.4	7	16.5	03	8	23
CRESSIDA	PANAMANIAN	23	51.7 N	147.7 W	06	24	M 41	5 NM	02	997.0	2.0	3.2	8	19.5			
POLAR ALASKA	LIBERIAN	23	47.3 N	154.6 E	18	15	M 48	2 NM	25	999.5	4.2	0.0	8	6.5			
EXPORT COURIER	AMERICAN	24	13.9 N	96.8 W	00	03	45	10 NM	02	1013.9	22.2	21.1	7	13	04	8	23
CRESSIDA	PANAMANIAN	24	49.5 N	154.3 W	12	27	M 45	2 NM	70	1010.0	- 1.0	0.0	7	19.5	27	10	23
GOLDEN GATE	AMERICAN	24	14.0 N	97.3 W	12	04	45	> 25 NM	02	1014.5	23.9	23.4	3	5	07	7	18
GOLDEN GATE	AMERICAN	25	12.9 N	95.7 W	00	04	45	10 NM	02	1013.3	21.1	18.9	5	8	05	10	24.5
LIONS GATE BRIDGE	JAPANESE	25	47.9 N	178.2 W	15	11	M 41	2 NM		1024.0	5.0	5.0	8	13			
PORTLAND	AMERICAN	26	54.7 N	139.1 W	12	07	45	10 NM	01	997.6	5.0	5.6					
TOYOTA MARU #12	JAPANESE	29	37.9 N	164.6 W	12	17	M 44	2 NM	63	998.0	14.0	12.0	6	11.5			
ALBERT MAERSK	DANISH	29	36.0 N	152.0 E	18	23	45	2 NM		1004.0	16.0						
PRES KENNEDY	AMERICAN	29	33.5 N	140.0 E	06	22	45	2 NM	07	997.0	18.9	18.3	6	10	13	8	13

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kn or waves ≥ 25 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

(Continued from page 230.)

east of Tokyo on the 16th. This wave moved eastward and expanded. The HERMINA, still headed toward Japan, was at 35°N, 150°E, with 45-kn winds, 16-ft seas, and 33-ft swells pounding her port side. The frontal wave was racing eastward under the long wave zonal flow which was far out of phase. The wave length was especially long with the major troughs inland of both coasts.

It was not until the 18th that the LOW started to deepen significantly and only gales were reported. By 1200, the pressure had dropped to 980 mb near 49°N, 173°W. The DYVI OCEANIC, at 49.6°N, 163.2°E, reported 30-ft seas and 33-ft swells at 0600. The VAN FORT, at 50.5°N, 168.5°W, measured 50-kn winds and 57-ft swells at 2000. The HOYO MARU, near 46°N, 176°W, was sailing with 55-kn winds, 33-ft seas, and 46-ft swells on her stern. Twelve hours later at 0000 on the 19th, the pressure had dropped 5 more mb. The VAN FORT, near 50°N, 168°W, fought 60-kn winds, while the DAIKI MARU, about 300 mi south, had 45-kn winds and 16-ft seas.

The storm appeared as if it were headed for Alaska, but late on the 19th, it turned southeastward. Several ships reported 40-kn gales, but the HOYO MARU topped them all with 23-ft seas and 26-ft swells near 48°N, 164°W. The LOW was now filling and weakening, and on the 21st, it split into three centers. The NORSE VIKING (48°N, 152°W) found 40-kn gales with 26-ft waves on her starboard side. Later that day, the original LOW was absorbed by the southernmost of the three, which then moved northeastward. The PORTLAND, at 53.5°N, 135.9°W, still had to contend with 59-kn winds at 1800.

This incipient storm formed on the 17th near Cheju-do, Korea. In the next 24 hr it traveled the length of Honshu, and turned to parallel the Kuril Trench. It was not until 0000 on the 20th that it concerned other than small fishing vessels. At that time, it was 977 mb, near 53°N, 150°E, and the JUJO MARU (49°N, 160°E) was beaten by 50-kn winds with 13-ft seas and 39-ft swells. East of the center and the occlusion, the KANAGAWA MARU was blinded by heavy snow driven by 40-kn southeasterly winds with 23-ft waves.

The LOW was moving northward along the coast of Kamchatka on the 21st. Ostrov Beringa measured 70-kn winds. There were two reports of 50-kn measurements in the Kuril Islands and the southern part of the peninsula. The highest ship wind was 45 kn, but the UNION PROGRESS was more concerned with the 20-ft seas and 25-ft swells in the cold water north of the Rat Islands. At 1200, the KANAGAWA MARU no longer had heavy snow, but the winds were now 50 kn out of the west with 28-ft swells. The central pressure was now rapidly rising, and the system became history on the 22d.

Tropical Cyclones, Western Pacific--Tropical storm Lorna blossomed briefly among the Caroline Islands toward the end of the month. She was first detected as a depression, near Truk on the 27th. She headed northwestward and reached tropical storm strength the following day after crossing the 10th parallel. Lorna was never more than a minimal tropical storm. Early on the 29th, she turned toward the southwest. Later in the day she weakened. Lorna fizzled out south of Woleai on March 1.

Casualties--The 2,980-ton Japanese freighter HEKIYO MARU and the 2,374-ton Somalian vessel KUN SHAN collided in fog about 126 km east of Hong Kong on the 17th. Five of the 21 crewmen aboard the HEKIYO were rescued by the KUN SHAN. High winds near Dubai, in the Persian Gulf, resulted in the oil rig WODOCO breaking loose and colliding with the drilling platform W.D. KENT. One man drowned and five were seriously injured.

Rough Log, North Atlantic Weather

April and May 1976

ROUGH LOG, APRIL 1976--This was a light month for storms across the Atlantic--comparable to a summer month. The storm centers were concentrated northwest of a line from Cape Race to eastern Iceland. There were fewer storms that moved off the U.S. East Coast, in fact only two. There were also fewer storms that formed or tracked over the water off the coast. The primary track was from Nova Scotia to the Denmark Strait and into the Norwegian Sea.

There were major differences in location of the mean monthly sea-level pressure centers. The Icelandic Low is normally 1008 mb east of Kap Farvel. This month it was 1007 mb near 55°N, 48°W. The 1025-mb Azores High was centered near 36°N, 32°W, versus the climatological position of 31°N, 33°W, at 1021 mb. A ridge stretched northeastward from the primary center with another 1024-mb center near 50°N, 15°W.

The principal anomaly center was a plus 10-mb center near 52°N, 16°W. There were three negative 3-mb centers--over the Davis Strait, near 54°N, 50°W, and over southern Nova Scotia. The Mississippi River Valley and Great Lakes Basin areas were included in a positive 3-mb anomaly area.

The upper-air flow at 700 mb was more meridional than the usual latitudinal. The trough off the U.S. East Coast was more pronounced, and there was a sharp ridge off the European Coast. There was a large positive height anomaly east of Ireland and another centered north of Lake Winnipeg. The area from Baffin Bay to the Barents Sea was covered by negative values.

Extratropical Cyclones--This storm actually had its origin in March but was of little consequence until April. It started as a small wave on a front over Cape Sable. High pressure from Canada pushed eastward north of the LOW resulting in its moving southeastward. At 0000 on April 1, the large 999-mb system was near 32°N, 56°W. The winds were in the breeze category. On the 2d, the HIGH was squeezing between this LOW and another over Iceland, tightening the gradient in the northeast quadrant. At 1200, the ELSFLETH was near 39°N, 48°W, and surprised by 50-kn winds with heavy drizzle. The seas were 23 ft and the swells 26 ft. The SHOZEN MARU, at 34°N, 44°W, had rain, 35-kn winds, obscured vision, and 13-ft waves. The frontal systems with this LOW had dissipated into only troughs.

At 0000 on the 3d, the 1002-mb LOW was at 31°N, 49°W. The ATLANTIC CARRIER (35°N, 40°W) and another ship (37°N, 45°W) both radioed reports of 40-kn winds. The seas and swells were running 16 to 20 ft. On the 4th, the LOW was moving eastward at a much faster pace and filling. It was identifiable until the 7th.

This storm formed over Florida, on the 8th, as a frontal wave. What else? At 0000 on the 9th, the 1000-mb LOW was near 31°N, 74°W, and the BRAZOS was near 29°N, 81°W, with 30-kn gales. EB15 was reporting 35-kn gales north of the center. At 1200, the MORMACVEGA (29°N, 80°W) reported 40-kn gales and 13-ft seas and swells. The storm was racing along the Gulf Stream and deepening. On the 10th at 0000, the 984-mb center was at 38°N, 66°W, and Ocean Weather Station Hotel measured 60-kn winds with 20-ft seas. On the other side of the center another ship reported 35-kn gales and 20-ft seas (fig. 45).

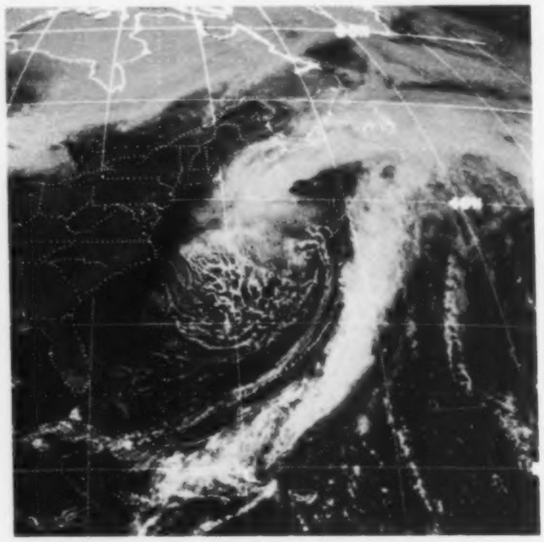


Figure 45.--There is an interesting cloud pattern southwest of the center of the storm.

The 8,348-ton Singapore-registered freighter SEA-TRADER (fig. 46) sank in latitude 33.2°N, 62.75°W, after heavy seas broke open a cargo hold. The 29 crew members were rescued by the 7,214-ton Greek freighter ARISTOKLEIDIS and landed at Bermuda.

At 1200 on the 10th, the USCGC RELIANCE, at 40°N, 68°W, was tossed by 45-kn winds, as was OWS Hotel with 23-ft seas. By 1200 on the 11th, the 982-mb center was over southwestern Newfoundland. The drilling rig VGBZ measured 50-kn winds with swells to 13 ft. Near 45°N, 59°W, the ATLANTICA MARSEILLE was hammered by 40-kn winds and 13-ft waves.

The LOW continued toward Kap Farvel leaving behind a small circulation over Nova Scotia. A ship reported a thunderstorm ahead of the front. The storm center passed over Kap Farvel about 0800 on the 12th. Ocean Weather Station Charlie measured 40-kn winds and 20-ft seas while Lima measured 50-kn winds. Twelve hours later, Lima had 40-kn winds and 26-ft seas, as Charlie reported 20-ft seas. The storm

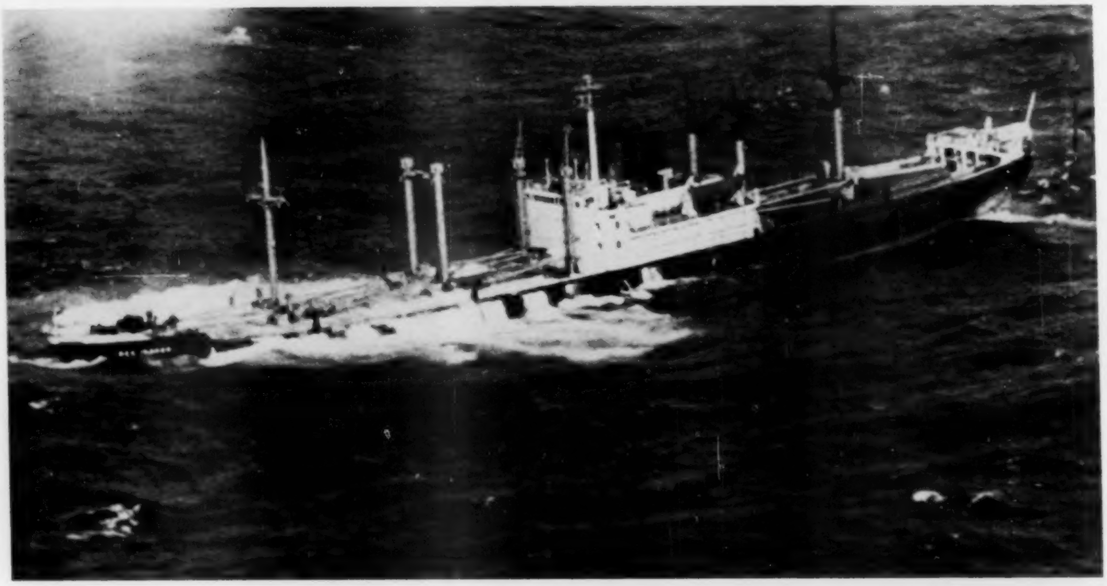


Figure 46.--The SEATRADER lies deep in the water and about to sink by the bow. Wide World Photo.

continued across Iceland and disappeared over the Norwegian Sea.

A LOW formed over the Strait of Belle Isle in the trough of a LOW that preceded it and was approaching the Davis Strait. It meandered southeastward very slowly at about the same pressure. On the 0000 chart of the 16th, another LOW formed on the front associated with the storm near 47°N, 49°W. By 1200, the two had combined into a 1004-mb LOW at 52°N, 46°W (fig. 47).

The ATLANTIC CONVEYOR and a trough behind the front converged at 50°N, 39°W, with 50-kn winds

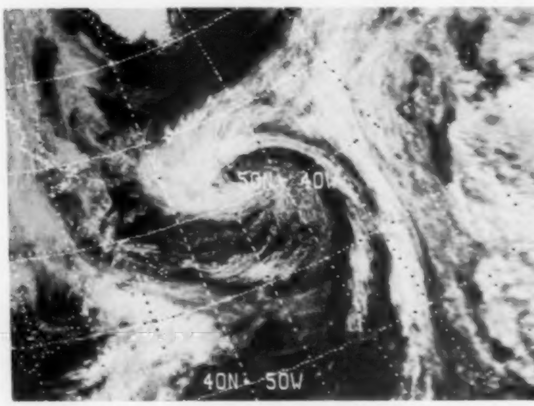


Figure 47.--A typical cloud pattern for a North Atlantic storm.

and 13-ft waves. To the south, the C. P. VOYAGEUR found 40-kn winds and 20-ft waves with the same trough near 46°N, 40°W. At 1200 on the 17th, OWS Charlie contended with 30-kn winds and 20-ft seas. A ship north of Trinity Bay logged 45-kn gales.

On the 18th, the LOW deepened rapidly, dropping 14 mb in 12 hr to 984 mb near 57°N, 36°W. The wind reports remained in the minimal gale category. The POST CHARGER, far to the south, near 45°N, 37°W, had 40-kn gales and 15-ft seas. At 1200 on the 20th, a ship, near 46°N, 22°W, had 40-kn with seas and swells of 26 ft. On the 20th, the LOW died on the Greenland coast.

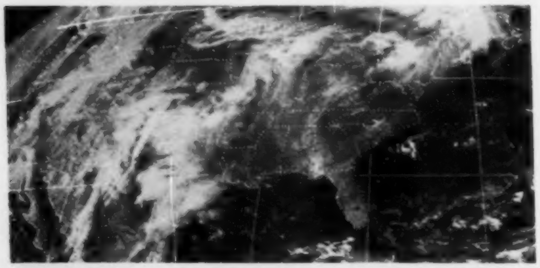
Monster of the Month--The predominant pressure center associated with this storm and the resulting tragedy was a high-pressure center off the Carolinas. The HIGH was over the Arctic Ocean, centered near the North Pole on the 6th. It moved southward across Canada and was over the central United States on the

12th. On the 14th, it was centered off the Carolina coast south of Cape Hatteras where it became relatively stationary at 1025 mb. Its western circulation extended to the Mexican coast. For several days a stationary front had paralleled the eastern slopes of the Rocky Mountains and into central Mexico, with a LOW near the Colorado-Kansas border.

On the 15th at 1200, the HIGH was 1026 mb. A 1002-mb LOW had moved southward to the southeast border of New Mexico. Wind reports from coastal stations and the buoys were only 10 to 15 kn. The oil drilling rig OCEAN EXPRESS (fig. 48) was being towed to a new location off the Texas coast. The center of the LOW dropped south to a point west of Monterey, Mexico, and at 0000 on the 16th was 996 mb (fig. 49). The pressure gradient increased and also the winds and seas. About 40 mi northeast of Corpus Christi, the OCEAN EXPRESS was in trouble. The winds and waves were estimated at 50 to 60 mi/h and 20 to 25 ft, respectively. Reportedly, the engine of one of the three tugs holding the rig quit, the towline to another broke, and the rig swung broadside to the storm and capsized. The rig quickly sank in 187 ft of water.

There were 35 men onboard; 13 died in an inverted rescue capsule (fig. 50). The captain was rescued from the rig by a helicopter only seconds before it sank. The helicopter was from the aircraft carrier LEXINGTON which was on training maneuvers in the area. The LEXINGTON also picked up the two rescue capsules.

Figure 48.--OCEAN EXPRESS, the oil rig that sunk in rough seas in the Gulf of Mexico on April 16. Note rescue capsules just below the helicopter pad. Wide World Photo.



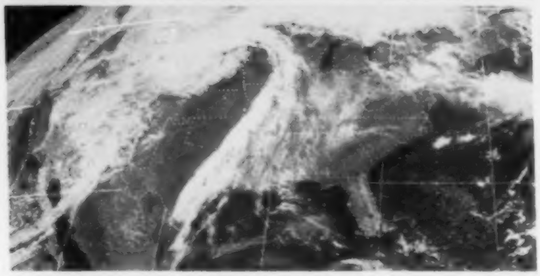


Figure 49.--These two SMS-1 satellite images show the weather conditions off the Texas coast at 1700 on the 15th (top) and 16th (bottom).

Figure 50.--The inverted rescue capsule lies alongside the aircraft carrier LEXINGTON prior to being hoisted aboard. U.S. Navy Photo.

Lake Superior was the source of this storm rather than the victim. It formed on the 18th and raced across Quebec Province. At 0000 on the 21st, it was over Newfoundland at 1002 mb pressure. As it moved over the water, it started to deepen. The BESSTRASHNIJ was buffeted by 50-kn winds and 16-ft seas at 46°N, 49°W, at 0000 on the 22d. By 1200, the LOW was 984 mb near 46.5°N, 42°W (fig. 51). Winds of 35 to 40 kn were blowing in the western and southern quadrants with waves of 20 to 23 ft. At 0000 on the 23d, the KANAGAWA MARU was about 120 mi from the 976-mb center with 40-kn winds and 15-ft seas. The KOMPETENTNII was practically at the center with a reported pressure of 976.5 mb. Back near Newfoundland, the BESSTRASHNIJ had 50-kn winds and 34-ft seas.

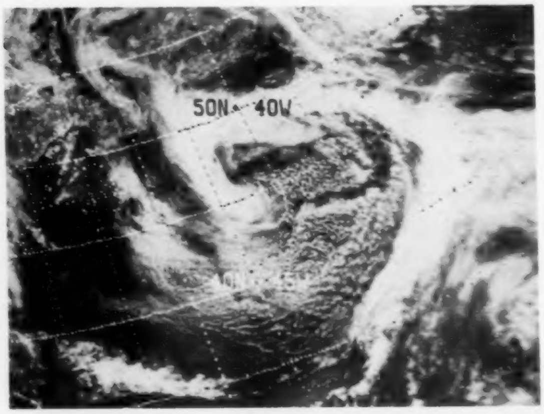


Figure 51.--The comma-shaped heavy cloud pattern west and north of the center indicates the area of maximum vorticity advection and probably the roughest weather.

At 1200 on the 23d, the ABIDA (36.5°N, 46°W) had only 35-kn gales, but the swells were 31 ft. Gales continued to blow in the southern half of the storm with the highest waves reported as 23 ft. About this time, the storm turned northward and weakened as another LOW approached from the west. By 1200 on the 25th, only the new LOW remained.

Casualties--The 6,400-ton Russian freighter PAVEL PARENAGO, Liverpool for Cleveland, arrived Tenerife, on the 20th, owing to alleged bad weather.

ROUGH LOG, MAY 1976--Low-pressure centers traversing the North Atlantic this month were fewer than normal and were more concentrated during the last half of the month. The primary track off the U.S. East Coast was fairly well represented with the centers forming farther off the coast than usual. Another primary path from across the Great Lakes and north of the St. Lawrence River crossed the Labrador coast and moved eastward into the Norwegian Sea. Three centers crossed the North Sea, and one from mid-ocean crossed the Iberian Peninsula.

The climatic monthly normal sea-level pressure for May has less definition of all the months. The gradient is very flat with only 10-mb difference between the 1012-mb Icelandic Low and the 1022-mb Azores High. The gradient or contrast this month was much greater. The Icelandic Low was 1000 mb near 60°N, 25°W, and the Azores High was 1026 mb near 32°N, 34°W. The pressure along the U.S. East Coast was near normal except for an anomalous 1011-mb LOW centered near Quebec. The 1016-mb isobar and zero departure isoline paralleled the U.S. East Coast and latitude 50°N across the water into the English Channel.

The major anomaly center was minus 12 mb centered with the Icelandic Low center near 60°N, 25°W. A negative 4-mb center was associated with the LOW near Quebec. The major positive anomaly was a large flat area that covered most of the ocean between latitudes 20°N and 48°N. The largest departure was 4 mb just south of the Azores Islands.

The upper-air circulation also was more intense with a tighter gradient than climatology indicates. There was an anomalous LOW south of Iceland vertically alined with the more intense surface LOW. The trough that normally lies off the U.S. East Coast was retrograded to west of the Appalachian Mountains. As would be expected, there was a large 103-m negative height anomaly of the 700-mb surface collocated with the Icelandic Low.

There were no tropical cyclones. The season normally starts in June, but in the last 45 yr, nine are known to have occurred during May.

Extratropical Cyclones--This storm formed over northern Alberta, Canada, on the 3d. It moved across the Provinces bringing snow. Late on the 6th, the 990-mb center moved over the Labrador Sea near Hamilton Inlet.

At 1200 on the 7th the LOW was centered near 56°N, 43°W (fig. 52). The AUGUST BOLTEN at 46°N, 49°W, was plotted as having 60-kn winds, yet the seas were only reported as 7 ft. Ocean Weather Station Charlie was in the warm sector of the occlusion with 15-ft seas.

Figure 52.--The circulation from two LOWs is obvious on this image.

By 0000 on the 8th the LOW had deepened to 978 mb near 59°N, 26°W. OWS Charlie had 35-kn gales and 20-ft seas behind the cold front. The occlusion was near OWS Lima which measured 40 kn and swells of 18 ft. At 1200 on the 8th the LOW moved over eastern Iceland and continued into the Greenland Sea.

Another center formed southwest of Iceland keeping the gradient to the south fairly tight. An Estonian ship, near 53°N, 26°W, reported 35-kn gales and 13-ft seas. Three other ships reported 15-ft swells. This center moved over Iceland and dissipated.

This storm was first analyzed near the juncture of the Missouri and Mississippi rivers on the 13th. It was not until the 15th that its circulation became organized as it moved over the Maritime Provinces. At 0000 on the 16th the 996-mb LOW was near 45°N, 58°W. At 1200 the first gale-force wind was reported by the NATHANAEL GREENE with 15-ft seas near 40°N, 56°W. At 0000 on the 17th the STADT WOLFSBURG, north of the center, found gales, and the drilling ship VGBZ measured 40 kn and 15-ft seas west of the center. At 1200 the HOLSTENDAMM in the vicinity of 32°N, 50°W (fig. 53) reported a 70-kn wind with a rain shower along the cold front. Southwest of the center, the MONSUN also had rain showers with 50-kn winds and 21-ft seas.

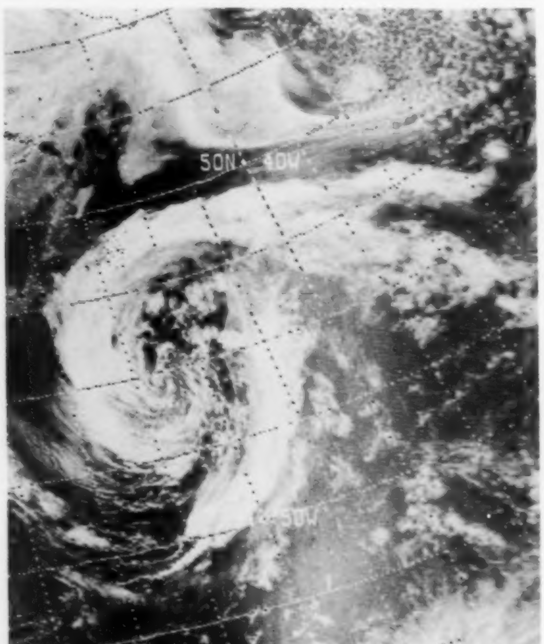


Figure 53.--The HOLSTENDAMM was beneath the heavy clouds along the cold front, and the winds were probably associated with a thunderstorm.

The LOW moved toward the southeast, an odd direction, from the 16th to the 18th. On the 18th it turned eastward and northeastward on the 21st. Winds of only 15 to 25 kn were plotted, but seas were running 12 to 15 ft near the front.

On the 22d the storm regenerated as its energy was reinforced by a cold front. At 0600 the PROYV, near 45.5°N, 30°W, reported 35-kn winds and 16-ft seas. At 1800, the 992-mb LOW was near 49°N, 25°W. The PROYV was now near 47°N, 30°W, and battling 40-kn winds and 20-ft seas. The STEFAN BATORY, at 51°N, 25.5°W, was only a few miles west of the 994-mb center at 0000 on the 23d, with 40-kn winds and 13-ft seas. The PROYV was slowly cruising northward and again reported 40-kn winds and 20-ft seas at 0600.

Early on the 24th the storm was moving due north, and a secondary LOW had formed in the southeast quadrant. On the 25th the storm turned northwestward toward the coast of Greenland and dissipated.

A weak LOW moved over Newfoundland and to sea on the 24th. On the 25th a frontal wave developed southeast of Cape Race. At 1200 it was 996 mb and growing. A ship reported 40-kn gales and 20-ft seas south of the center.

At 0000 on the 26th the 980-mb storm was centered near 52°N, 35°W. The center was very near Ocean Weather Station Charlie which measured 40-kn winds and a pressure of 981.4 mb. The ROMAN PAZINSKI was buffeted by 47-kn winds ahead of the front near 41°N, 34°W. At 0600 Charlie measured 44-kn winds and 20-ft seas. In the same general area two other ships estimated 40-kn winds. The FEDERAL ST. LAURENT was near 54°N, 25°W, with 35-kn winds and 21-ft seas. At 1800 the MOSEL EXPRESS, at 50.8°N, 24.6°W, had 37-kn winds and 25-ft swells.

The LOW was now almost stationary. OWS Charlie was still recording 40-kn winds at 0000 on the 27th. The seas and swells were 23 ft. By 1200 the wind had picked up to 45 kn and the seas to 28 ft. The IDEFJORD, near 54°N, 35°W, also had 44-kn winds and 23-ft seas.

On the 28th the LOW started to drift southward and weaken, and on the 29th another LOW approached from the west and quickly absorbed the old circulation.

A weak but large low-pressure area dominated the Gulf of Mexico on the 22d. It drifted eastward and was over the Gulf Stream by the 25th. At 0000 the EB16 interrogation indicated 35-kn winds. At 1200 a ship, near 38°N, 69°W, fought 35-kn gales. At 1200 on the 26th the 1001-mb LOW was near 40°N, 60°W. At 1800 the QUEEN ELIZABETH 2 reported 26-ft swells near 42°N, 62°W.

By 1200 on the 28th the 993-mb LOW was near 47°N, 42°W. The LOW passed about 150 mi east of OWS Charlie at 1200 on the 29th. The TILDIN, near 62°N, 40°W, had 37-kn gales. At 1200 on the 30th the DART AMERICA was at 47.9°N, 24°W, with 54-kn winds and 25-ft waves. On the 31st another LOW approached from the west, and by 1800 this LOW was only a trough.

Casualties--The 58,000-ton Dutch tanker CAROLYN JANE was dragged aground at Malta by a storm early in the month. The 4,734-ton UNITED FORTUNE ran aground in the Mississippi, near New Orleans, on the 10th due to a wind and rain storm.

Rough Log, North Pacific Weather

April and May 1976

ROUGH LOG, APRIL 1976--The North Pacific lived up to its name this month. There were more low-pressure centers, and, therefore, they were generally smaller and not as intense. Along the western shore the storms moved off the continent or originated farther south than usual. Also, the LOWs tracked more easterly than the normal northeasterly direction. The storm track along the Aleutians was normal and consisted mainly of the northernmost storms rather than the southern ones. A secondary storm track out of the central ocean into the Gulf of Alaska became a primary track. There were two obvious crossroads where storm tracks crossed at large acute angles. The mean locations were near 52°N, 173°W, and 47°N, 158°W.

The mean pressure pattern was more intense than climatology. As usual, the Aleutian Low and the Pacific High dominated the picture. The April climatology indicated the Aleutian Low is split into four centers along approximately 58°N, with the deepest center 1009 mb. This month there was one main center at 1004 mb over Kodiak Island, with a lesser center of 1011 mb inland of Sakhalin Island. The Pacific High had two 1026-mb centers along latitude 32°N at longitudes 175°W and 153°W. According to climatology there are three centers: 1021 mb at 30°N, 170°E; 1022 mb at 33°N, 157°W; and 1023 mb at 33°N, 146°W.

The anomaly pattern was weak. A negative 6 mb was south of Kodiak Island with a negative anomaly trough paralleling the Aleutian Islands and the primary concentration of storm tracks. A large block-shaped area of positive values was bounded by latitudes 20° and 40°N and longitudes 170°E and 140°W, with two positive 4-mb centers.

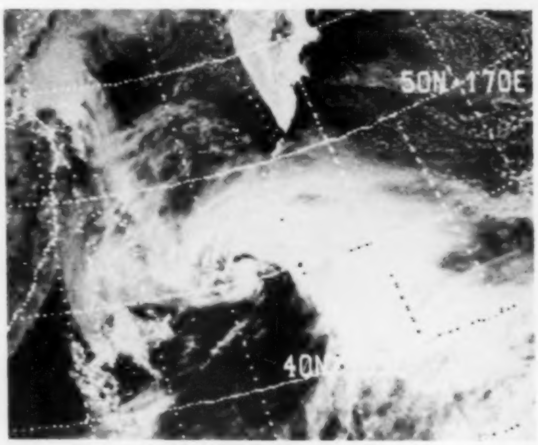
The upper-air flow at 700 mb was zonal following the parallels of latitude except for a shallow trough off the Asian coast and a sharper trough off the North American coast. There was an anomalous low center near Wrangel Island with an associated negative anomaly center. Another negative anomaly center was over the Fox Islands. A positive anomaly center was near 35°N, 170°W.

There were two tropical cyclones--typhoon Marie and tropical storm Nancy.

Extratropical Cyclones--The most violent storm of this month originated in March, so it is written up in that month. This storm followed on the heels of that storm. It moved out of Manchuria and across the Sea of Japan on the 2d. At 0000 on the 3d, it was 994 mb near Ostrov Iturup. The SANTA MONICA MARU was southeast of the center and east of the occlusion, near 42°N, 158°E, with 40-kn southerly winds and 16-ft waves. At 1200, the BREWSTER was in the vicinity of 47°N, 159°E, and ahead of the center (fig. 54). She was mauled by 70-kn winds from the southwest. On the 4th, the REXTAR was sailing into 30-ft seas and swells near 48°N, 173°E.

The storm continued to track eastward, and at 0000 on the 5th, it was 980 mb near 52°N, 169°W. Four ships fought 40-kn winds. One of the ships with the first three call letters of A8I, near 40°N, 168°W, also contended with 20-ft seas and 36-ft swells. The SHOGEN MARU, near 47°N, 180°, had 26-ft swells.

On the 6th, the storm was headed southeastward with gale-force winds. At 0000 on the 7th, the PFQU was at 39°N, 143°W, with 55-kn northwesterly winds, 25-ft seas, and 33-ft swells. The PACEMPEROR, along with several other ships, had 40-kn gales, but the swells were 30 ft. A ship off the northern California coast had 45-kn gales. As the storm center



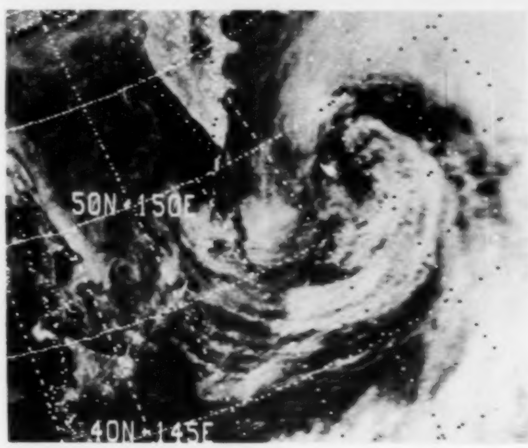


Figure 54.--The image on the left was obtained about 2300 on the 2d and the one on the right about 0000 on the 4th. Note the rapid movement and expansion of the storm.

approached 130°W, it turned northward to dissipate on the 8th.

An unstable wave formed on a cold front south of Kyushu on the 3d. It moved eastward, then northeastward, until it was 998 mb, near 40°N, 165°E, at 1200 on the 5th. The HAGOROMO MARU (39°N, 160°E) had heavy rain driven by 45-kn winds. A ship northeast of the center had 40-kn gales. Winds of 40 kn continued as the storm deepened and continued its northeastward track.

At 0000 on the 7th, the center was near 52°N, 176°W, and 968 mb. A ship found 50-kn winds at 47°N, 180°, and another ship had 40-kn winds near 47°N, 174°W, with 30-ft swells. At 1200, the LOUIS L.D. also battled 50-kn winds at 51°N, 172°W. Gale-force winds continued as the storm moved along the Aleutians, but the storm was decreasing in intensity. Late on the 8th, the storm turned northwestward when over Bristol Bay and was absorbed by the next storm on the 10th.

This LOW appeared off Japan almost fully developed. At 0000 on the 4th, it was 994 mb and by 1200 was 972 mb. There were three reports of winds of 50 kn around the center: the DAIAN MARU near 41°N, 145°E, and two other ships whose call letters could not be read. Some distance to the south, the LEVEN FISHER (34°N, 145°E) had only 40-kn winds with 20-ft waves.

On the 8th, the HIKAWA MARU had 40- and 45-kn winds with 25- and 30-ft waves. At 1200, the YAMATADA MARU was near 41°N, 149°E, with 50-kn winds. Another LOW had formed south of the main center and was rotating around the eastern side. South of the primary center (972 mb), the TOKUYO MARU had 45-kn winds, 20-ft seas, and 26-ft swells. Far to the south, the OJI MARU (38°N, 164°E) and another ship to the east fought 40-kn winds and seas up to 23 ft.

The storm was moving fairly slowly toward the northeast. The INDIAN MAIL (43°N, 166°E) was sailing into 35-kn gales with 16-ft seas, and 41-ft swells. To the west, the WRANGELL MARU (43°N, 157°E) had 45-kn northwesterly winds, 23-ft seas, and 33-ft swells (fig. 55).

On the 10th, the storm started weakening and split into two centers with the original one disappearing. The other center which was to the north continued northeastward. The JAMSONS was at 44°N, 171°W, with 45-kn gales and 20-ft swells. This LOW moved through the Bering Strait and into the Chukchi Sea.

The reports from Midway Island and two ships, the OREGON STANDARD and SEALAND FINANCE, on the 14th, identified this frontal wave. It raced northeastward and was 977 mb, at 0000 on the 16th, near 50°N, 156°W. Ocean Weather Station Papa measured 40-kn winds, and a ship nearer the center had 16-ft seas. At 0000 on the 17th, the LOW was producing 45-kn winds and high swells. One of the ships, near 52°N, 154°W, reported 41-ft swells, and the other, the KIKUKO MARU (53°N, 147°W), had 21-ft swells. On the 18th, the storm died out as it stalled off the coast of Alaska.

The last part of the month was fairly quiet. The LOWs did not produce any winds plotted on the weather charts higher than gales or seas above 20 ft. On the 29th, a LOW formed over Hokkaido and moved eastward with snow over the Kuril Islands. At 0000 on the 30th, a ship reported 40-kn winds south of the 992-mb center, which was near 46°N, 153°E. Later in the day, the HOYO MARU had gales with 20-ft swells.

The storm was traveling almost due eastward and passed the LOUIS L.D. leaving 40-kn winds behind and 20-ft seas. On May 2, the storm took on a northerly component in its path. The STAR BILLABONG, near 47°N, 161°W, had 50-kn winds on the starboard side. To the south, along the front, a ship radioed a 45-kn report from 36°N, 166°W. At 1200, the storm's pressure was 965 mb, and the GEH YUNG, at 45°N, 159°W, had 23-ft swells (fig. 56).

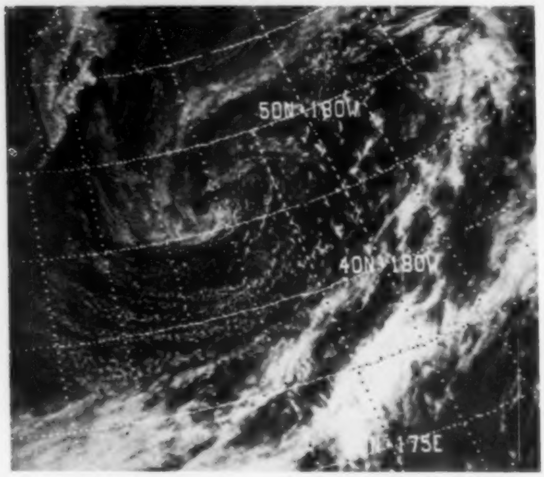


Figure 55.--Although a large storm, the cloud cover was not heavy.

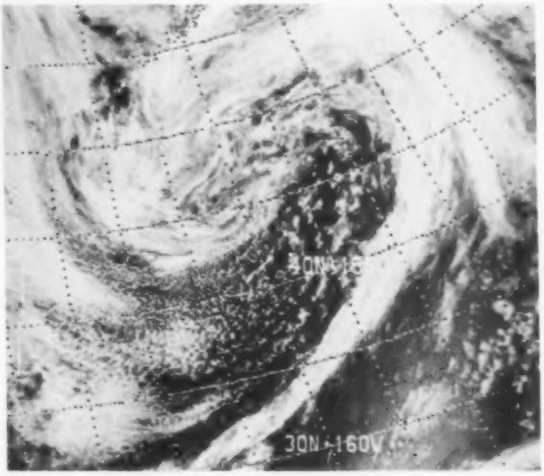


Figure 56.--The GEH YUNG is under the heavy cloud cover.

On May 5 the storm was 977 mb near 50°N, 168°W. Gales were blowing south of the center. Two ships reported 23-ft swells. On the 7th, the storm disappeared in the Gulf of Alaska.

Tropical Cyclones, Western Pacific--Marie and Nancy were the April tropical cyclones. Marie reached typhoon strength while Nancy remained a tropical storm. Marie developed southeast of Yap on the 3d. She moved on a typical parabolic path, recurving near 10°N, 130°E. During the northward part of this recurvature she reached peak intensity (fig. 57). From the 9th through the 12th, winds near her center exceeded 100 kn; they reached 115 kn on the 11th. On the 12th, the accelerating and weakening storm crossed the 20th parallel near 132°E. Marie continued to weaken as she skirted Honshu 2 days later. She was the first April storm to do so in 20 yr.

Nancy formed near Eniwetok Island on the 25th. She moved west-northwestward as a minimal tropical storm from the 25th to May 1. On May 1 Nancy passed within 100 mi of Saipan and turned toward the southwest. The following day she was just a weak depression.

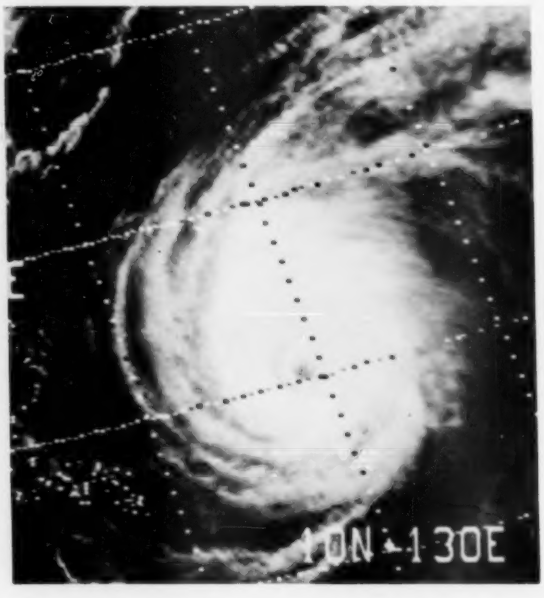


Figure 57. --The eye of typhoon Marie near peak intensity at 15°N, 130°E.

Casualties--Thick fog over the Inland Sea and the Pacific resulted in two collisions on the 22d. The 3.5-ton fishing boat TOKURYO MARU and the 9,053-ton ferryboat SUZURAN MARU collided, and the fishing boat sank with the two fishermen rescued. The 2,850-ton freighter GYOSEI MARU and the 197-ton fishing boat TAIYU MARU also collided with damage to both vessels.

The BARGE 419 in tow by the tug SEA MONARCH broke adrift during gale-force winds, on the 27th, and stranded stern first on Montague Island, Alaska.

ROUGH LOG, MAY 1976--The number of storm tracks was near normal, but they were more widely dispersed than usual. The two primary source areas, southern Japan and northern Manchuria, were fairly well concentrated, but once over the water, their paths scattered. In general the storms from southern Japan moved eastward between latitudes 35° and 45°N to midocean, then turned northeastward into the Gulf of Alaska. The Manchurian storms crossed the Sea of Okhotsk and then into the Bering Sea.

The pressure pattern and centers were nearly a duplicate of climatology except for central pressures. The Aleutian Low was about 3 mb lower and the Pacific High 4 mb higher than climatology. The primary LOW was 1006 mb, near 57°N, 150°W, centered in the Gulf of Alaska. Two 1007-mb subcenters were over the Bering Sea. The Pacific High, at 1027 mb, was centered near 32°N, 145°W.

The anomalies were not large. The deepest was minus 7 mb in the Gulf of Alaska near 55°N, 141°W. There was a plus 4-mb center at 33°N, 150°W.

The upper-air pattern was also near normal with a slightly tighter gradient than climatology because of more intense central pressures. The flow across the water was predominantly zonal with major troughs off the west coast of North America and another off the east coast of Asia.

There were two severe typhoons, Olga and Pamela.

Extratropical Cyclones--This storm was over the Sea of Japan on the 1st. By 1200 on the 2d it was 992 mb near 40°N, 159°E, with minimal gales. Swells were running about 10 ft in the southeast quadrant. At 1200 on the 3d the cold front passed a ship, near 37°N, 174°E, treating it to obscured skies, heavy drizzle, 40-kn gales, and 16-ft swells. At 0000 on the 4th the LINGAYEN, near 40°N, 178°E, had a thunderstorm with 40-kn gales associated with a trough behind the front (fig. 58). Several other ships reported 35-kn gales.

By 0000 on the 5th the 977-mb LOW was centered near 50°N, 166°W. A Japanese-registered ship, near 46°N, 172°W, had 45-kn westerlies, 20-ft seas, and 23-ft swells. Another ship, near 43.5°N, 167.5°W, had 40-kn southwesterly gales and 23-ft swells.

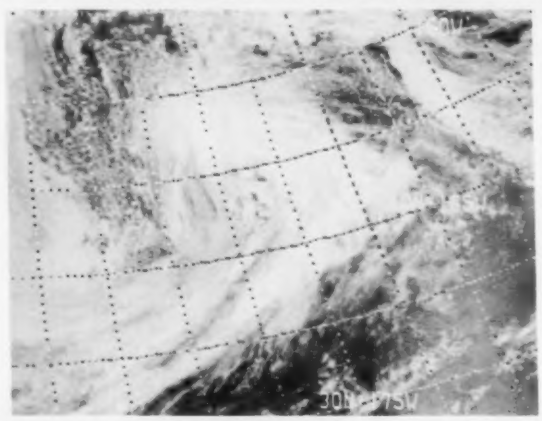


Figure 58. --No center of the storm is readily apparent on this satellite image.

As the storm approached the Gulf of Alaska on the 6th, it was decreasing in intensity, and on the 7th only a depression in the isobars indicated its existence.

The first indications of this frontal wave were ship reports south of Kyushu and steady rain over the Island late on the 2d and 3d. The wave moved northeastward, south of the islands, as a weak system until the 6th when it started deepening. At 0000 the EASTERN JADE found 35-kn gales and 12-ft seas near 35°N, 156°E.

At 1200 on the 7th the storm had a central pressure of 968 mb. There were no ships plotted south of the center, but the gradient would indicate gale-force or higher winds (fig. 59). At 0000 the ships were reporting. The JAPAN POPLAR was swept by 50-kn winds near 46°N, 177°W. The following four ships all reported 45-kn gales and the highest waves indicated: CAMARA - 18 ft (43°N, 176°W); PACBARON - 23 ft (44°N, 176°E); JAPAN CEDAR - 23 ft (50°N, 166°W); and an unidentified ship - 13 ft (44°N, 169°W). At 0000 on the 9th the EASTERN HILL was about 400 mi southwest of the 974-mb storm with 50-kn winds and 21-ft seas. Another ship 500 mi due south fought 45-kn winds and 20-ft seas. At 1200 the SAJANSKIE GORY was sailing into 45-kn gales northwest of the center.

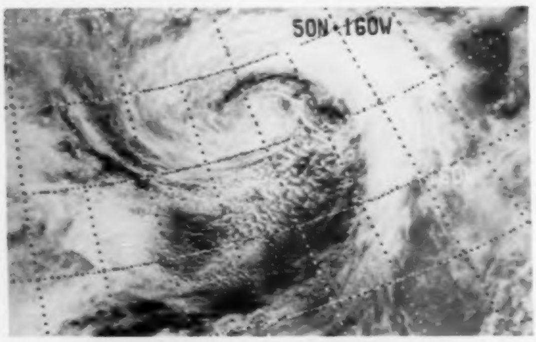


Figure 59.--The heavy cloud cover and dense cumulus-type clouds south of the center indicate a more severe storm than the few reports indicate.

On the 10th the storm started the dissipation process over the Gulf of Alaska, and on the 11th it disappeared.

A low-pressure center moved across the Bering Sea on the 22d. That center filled, and another formed east of the Alaska Peninsula on the 23d. It moved across the lower Gulf of Alaska. At 0000 on the 24th the 994-mb LOW was near 53°N, 147°W, and the AKAISHI MARU reported 35-kn gales near 52°N, 149°W. Late on the 24th the storm curved northward to make a cyclonic loop. At 0000 on the 26th the ALEUTIAN DEVELOPER, at 54.1°N, 164.7°W, was hit by 50-kn northwesterly winds. The LOW was absorbed by another system on the 27th.

On the 28th, a LOW formed over the Kenai Peninsula and moved southward. At 0000 on the 29th, the 1000-mb LOW was near 51°N, 142°W (fig. 60). The

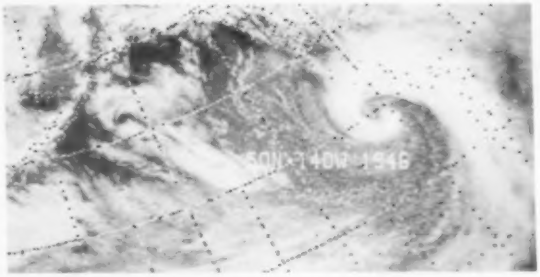


Figure 60.--This maritime LOW formed and deepened rapidly only to move inland and weaken over the mountains.

AKADEMIK BERG battled 51-kn northwesterly winds at 55.4°N, 156°W, and the SERGEY YESENIN fought 60-kn winds at 54.1°N, 153.6°W. On the 30th a ship, at 49°N, 132°W, braved 45-kn winds with 20-ft waves. Another ship, at 47°N, 130°W, had 21-ft waves. The storm now had curved northward again and moved inland, about 0600, just north of Vancouver Island.

Tropical Cyclones, Western Pacific--Olga formed north of Yap Island on the 12th. She developed slowly while moving west-northwestward. On the 18th, just after Olga crossed the 15th parallel near 126°E, the AGANO MARU encountered 45-kn winds and 12-ft seas just south of her center. Olga did not reach typhoon strength until the 20th. She was headed for Luzon. The following day, generating 100-kn winds, Olga crashed ashore and moved across the island. Her strong winds and torrential rains (figs. 61 and 62) wreaked havoc for the next 4 days as Olga meandered northward just off the west coast of Luzon. Floods resulted in more than 50 deaths. A large stretch of dike collapsed, flooding several villages in the rice-rich plains north of Manilla. Nearly 140,000 people had to evacuate to high ground, and at least 15,000 houses were under water in central Luzon. Some areas in Manila and surrounding provinces were reported under 6 ft of water. A Panamanian-registered

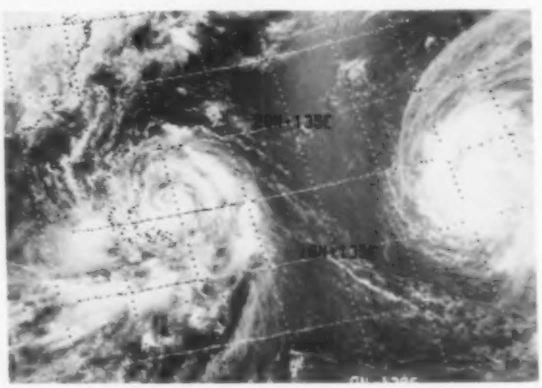


Figure 61.--Typhoon Olga is ravaging Luzon with torrential rains while typhoon Pamela is bearing down on Guam with wind gusts to 165 kn.

Figure 62. --Winds from typhoon Olga pushed the JESSMAG II aground against the sea wall of Manila Bay. Torrential rains flooded low-lying communities. Wide World Photo.

freighter ran aground off Mindoro Island. The 18-man crew was rescued by a U.S. destroyer. By the 26th the weakening storm was accelerating northeastward and turning extratropical. She dissipated on the 27th near Okinawa.

While Olga was ravaging Luzon, Pamela was ripping over Guam with 130-kn winds and torrential rains. Pamela had formed near Truk on the 14th. She developed quickly and headed northwestward. Satawan Atoll in the Caroline Islands suffered under 50- to 60-kn winds on the 17th. By the 19th she had crossed the 10th parallel and was generating 100-kn plus winds. The following day she was a supertyphoon bearing down on Guam. Winds reached 120 kn with gusts to 165 kn destroying at least half of the buildings on the Island. It was the worst storm to hit Guam since typhoon Karen in November of 1962. Damages were estimated at more than $100 million. Three persons were known dead on Guam, and ten people died on Truk.

Pamela remained potent after leaving Guam. Winds near her center reached 135 kn on the 22d as the supertyphoon continued northwestward. The following day winds began to drop as the storm slowed and started turning northeastward. On the 28th Pamela was extratropical but still a severe storm. At 0000 the storm was near 39°N, 155°E, and the ASIA GOLD, at 40°N, 162°E, fought 50-kn winds. At 1200 the FUJISAN MARU was pounded by 25-ft seas and swells driven by a 40-kn wind near 39°N, 157°E, and the KAIWO MARU, near 36°N, 156°E, was rocked by 26-ft swells.

At 0000 on the 29th the 970-mb storm was at 46°N, 161°E. The JUNEAU MARU (47.5°N, 165°E) was on the eastern edge of the cold front with 45-kn gales and 33-ft swells. Seas and swells of 15 ft were common south of the center. A ship about 300 mi southeast of the center fought 26-ft waves at 0000 on the 30th. The storm was no longer significant by June 1.

Casualties--The 13,443-ton British motor vessel BARON MACLAY had a number of mooring lines parted and hull damage due to heavy swell. The 57,318-ton British motor vessel IRON SIRIUS was undergoing repairs at Port Kembla, Australia, on the 24th for alleged heavy weather damage.

Marine Weather Diary

NORTH ATLANTIC, AUGUST

WEATHER. The favorable weather that is characteristic of summer continues into August, the warmest month of the year over the North Atlantic. The monthly pressure analysis shows the 1022-mb subtropical High centered near 35°N, 43°W, while the Icelandic Low, a broad, flat, east-west trough, reaches its lowest pressure (1008 mb) over Hudson Strait.

WINDS. Over the middle latitudes (40° to 60°N), winds from the southwest through the northwest occur with the greatest frequency. North of latitude 60°N, they become northerly between Greenland and Iceland, and variable south of Iceland and over the southern Norwegian Sea. The prevailing winds over the North Sea are from the westerly quarter of the compass. Between 40° and 25°N, the prevailing direction is from the north and northeast over the extreme eastern Atlantic, and from the south and southwest over the western ocean. Northwesterlies--known by many names, including mistral, etasians, and maestro--blow over the Mediterranean Sea. The northeast trades of the Atlantic lie principally between 25° and 15°N, extending to the South American coast over the Caribbean Sea. Near the approaches to the United States at these latitudes, the trades become more easterly--the Gulf of Mexico has prevailing easterly winds. Southeasterlies are dominant near the Equator, between South America and Africa. Windspeeds on the North Atlantic in August average slightly more than force 3, with lower speeds over the western Mediterranean, the Davis Strait, and the Gulf of Mexico.

GALES. Winds of gale force, except in tropical cyclones, are very infrequent south of 52°N. North of this latitude, gale frequencies of about 5 percent are fairly common, with maximum frequencies of 10 percent or more over the Norwegian Sea and the waters south and west of southern Greenland.

EXTRATROPICAL CYCLONES. A few moderately strong summer LOWs move about north of 40°N. Storms that attain severe intensities during August are usually of tropical origin. Primary storm tracks for extratropical cyclones are from Hudson Bay to Davis Strait, and from east of the James Bay region and the eastern Grand Banks to just south of Iceland and then eastward through southern Scandinavia. A short primary track lies off the U. S. East Coast. A secondary storm track crosses eastern Lake Superior before joining the primary track over central Quebec.

TROPICAL CYCLONES. August is one of the principal months in the North Atlantic hurricane season, ranking second behind September in tropical storm development and also in the number of these storms that attain hurricane force. An average of 2.4 tropical storms occur during August, and 1.5 or 2 out of 3 develop to hurricane intensity. A maximum of seven cyclones occurred in August 1933; and, in contrast, no storms were reported during 1941 and 1961. In general, the level of tropical cyclone activity increases as August advances, with the likelihood of storm occurrence being more than twice as great in the last 10 days as during the first 10 days of the month. The spawning area of tropical cyclones is much larger in August than during the preceding month. Some tropical cyclones originate as disturbances over southwestern portions of the "African Bulge," intensify into tropical depressions southwest of the Cape Verde Islands, gather strength as they are carried across the lower latitudes of the North Atlantic by the prevailing easterlies, and then enter the Caribbean, Gulf of Mexico, Florida, or the western Atlantic, as fully developed hurricanes. A characteristic of this activity is the split mean storm track around the Bahamas, with one branch passing to the north of the islands, where it recurves off Cape Hatteras, and the other over the southern portion of the island chain.

SEA HEIGHTS of 12 ft or more are encountered more than 10 percent of the time over a portion of the northern ocean south of southern Greenland and several hundred miles southwest of Iceland. Two other areas are also observed. One lies west of the British Isles, while the other is hosted by the Denmark Strait.

VISIBILITY. In general, fog is both less frequent and less extensive than earlier in the summer. Percentage frequencies of visibilities less than 2 mi occur 10 percent or more of the time north of a line from Cabot Strait southeastward to include the Grand Banks, thence northeastward to near 50°N, 35°W, northward to 65°N, 35°W, then southeastward to Scotland. The line then extends north- and eastward to the northern coast of Norway. A 20-percent oval-shaped area, about 600 mi in diameter, is centered off Newfoundland near 50°N, 50°W. Another 20-percent area is north of Iceland over the southern Greenland Sea.

NORTH PACIFIC, AUGUST

WEATHER. Mild summer weather continues over the North Pacific. Fog decreases, but both tropical and extratropical cyclones are more numerous. Temperatures reach their maximum for the year. By the middle of the month, the 1010-mb Aleutian Low has reappeared over the northern Bering Sea, near 61°N, 178°W. The subtropical High (1025 mb) is centered near 38°N, 152°W, in August.

WINDS. The northeast trade winds are the most persistent feature. They prevail south of about 35°N, and to 40°N over the eastern ocean. Over the Philippine and South China Seas, they quickly shift to the southwest monsoon. Off the Asian coast, the winds turn to southerly, and continue to shift to southwesterly over the northern latitudes. Over the western Bering Sea, they are westerly. Over the central ocean north of latitude 40°N, and over the eastern Bering Sea, the prevailing direction is southwesterly. The winds over the Gulf of Alaska are westerly, shifting to northerly along the American coast. Winds of force 3 to 4 generally account for over 50 percent of the speeds.

GALES, although unusual in areas not affected by tropical cyclones, do occur more than 5 percent of the time over the heart of the Bering Sea, along the easternmost capes of Kamchatka, and northwest of the Bering Strait. Owing to the influence of tropical cyclones, another small area of greater-than-5-percent frequency is centered near 25°N, 134°E.

EXTRATROPICAL CYCLONES. The number of extratropical cyclones is slightly higher in August than in the preceding month. Most of these storms form off the coast of Japan and move northeastward into the Bering Sea. Others enter the Bering Sea after developing off the southeastern tip of Kamchatka; these storms often journey as far north as Kotzebue Sound. Still another primary cyclone track scampers toward the Gulf of Alaska from a point near 51°N, 158°W.

TROPICAL CYCLONES. The frequency of tropical cyclones in the western North Pacific reaches a peak in August and September. About five tropical storms can be expected in August; three or four reach typhoon intensity. Typhoons in August are displaced farther to the north than in July and have less of a tendency to pass directly over the northern Philippines. Some move directly toward Japan and Taiwan; others may pass over Japan after recurving over the Yellow Sea. Those storms that do enter the South China Sea usually move west-northwestward into the Gulf of Tonkin and North Vietnam.

Over tropical waters west of Mexico, four or five tropical storms usually occur--a maximum for any month. The average duration of these storms is 6 days, and about half attain hurricane intensity. As in July, cyclones usually move in a west-northwesterly direction out to sea, where they almost always die after meeting colder waters and more stable air. Occasionally, however, one recurves before it has moved too far from the coast and moves inland over Baja California or the Mexican mainland.

SEA HEIGHTS. During August, sea heights of 12 ft or more are rare and occur less than 10 percent of the time across the entire North Pacific Ocean.

VISIBILITY improves very slightly during August. An area about 300 mi in diameter, where the visibility is less than 2 mi over 40 percent of the time, is centered just south of the Kamchatka Peninsula. The 30-percent line surrounds this area, reaching into the Sea of Okhotsk and to the Near Islands. The 10-percent line includes the southeastern half of the Sea of Okhotsk to 40°N at 160°E, along 40°N to 170°W, to 53°N, 137°W, to the Kenai Peninsula of Alaska. This area includes all of the Bering Sea.

NORTH ATLANTIC, SEPTEMBER

WEATHER. With the approach of autumn, subdued weather conditions that characterize the summer season over the higher latitudes gradually give way to increased cyclonic activity resulting from moderate intrusions of colder air. The Icelandic Low deepens to about 1006 mb, and is centered roughly halfway between Iceland and southern Greenland. The Azores High (1021 mb), centered near 33°N, 40°W, is a little weaker than in August.

WINDS. Almost without exception, the prevailing winds are westerly between 40° and 60°N. However, over the Grand Banks and the waters east of there to about 40°W, southerly winds prevail, and winds are variable south of Nova Scotia and over the Bay of Biscay. Speeds across this latitudinal belt are generally about force 4. South of 40°N, somewhat lighter winds average about force 3. Wind directions are frequently variable between 30° and 40°N, along the axis of the subtropical High, but northerlies dominate between 20°W and the Strait of Gibraltar. Between 30° and 10°N, easterly winds predominate over the western ocean (northeasterly over the Caribbean Sea), and northeasterly winds are the rule over eastern waters. Northwesterly winds blow over the Mediterranean, and southeasterlies are common over the extreme southern North Atlantic. Northerly winds prevail south of the Denmark Strait, while southwesterlies predominate over the Norwegian Sea. Northwesterly and southeasterly winds are most common over the southern approaches to the Davis Strait. Windspeeds north of 60°N average force 4 east of Greenland, but near the Davis Strait, more reports of force-2 winds are received than of any other speed group.

GALES. The frequency of gales increases in September, particularly over northern latitudes. Frequencies of 10 percent are found just south of Greenland's southern tip, over the open waters between northern Labrador-southern Baffin Island and southwestern Greenland, over the Norwegian Sea, and over the waters north and south of Iceland. The highest frequency, 20 percent, is found over waters well north of Iceland, and over a portion of the Norwegian Sea. Elsewhere, 5-percent frequencies are fairly common north of 50°N. South of 40°N, gales are unlikely to be encountered except in storms of tropical origin.

EXTRATROPICAL CYCLONES are more frequent than in August, and occasional severe storms may be encountered. Primary storm tracks lead northeastward from the waters off Labrador and Newfoundland to southern Iceland, and then over the Norwegian Sea. Another major storm track enters the Davis Strait from the Hudson Bay-northern Quebec region, while a third advances up the Baltic Sea from southern Scandinavia into Russia. One secondary storm track crosses the Straits of Mackinac on its way from the Great Plains to the primary track over Labrador. The storm track off the U.S. East Coast has moved seaward and extends from off Cape Hatteras to Sable Island.

TROPICAL CYCLONES. Tropical storm activity reaches a peak in September. Climatology indicates that an average of 3.3 tropical storms occur in September, 2 of which develop to hurricane strength. As many as seven tropical storms were reported in September (1949), while in 1930 there were none. The entire western ocean is subject to these storms, many of which originate east of the West Indies and move westward over or north of these islands, either to enter the Gulf of Mexico, or to recurve northeastward over western waters. Some storms entering the Gulf recurve over Florida and often parallel the U.S. East Coast. Another breeding ground for tropical cyclones is over the Caribbean, east of Nicaragua. Many trop-

ical storms or hurricanes are still packing considerable punch when they reach northern shipping routes.

SEA HEIGHTS of 12 ft or more have a frequency of 10 percent or higher over most of the North Atlantic between 50° and 65°N, while small areas of 20-percent frequency occur off Greenland's southern tip and over the Denmark Strait.

VISIBILITY. Percentage frequencies of visibility less than 2 mi exceed 10 percent north of a line drawn from the western Labrador Sea eastward to 57°N, 48°W, and then southwestward to encompass all of Newfoundland and the Grand Banks. From there, the line extends north-northeastward to the waters south of the Denmark Strait, and then eastward, barely missing the southern tip of Iceland, before dipping southeastward to include the Pentland Firth and the Hebrides. The line then passes east of the Shetland Islands before entering the Norwegian Sea midway between Iceland and Norway. Percentage frequencies of visibility less than 2 mi decrease to less than 10 percent over the central and northern portions of the Davis Strait, but increase to more than 20 percent over the northern reaches of the Labrador Sea above 60°N, and over the waters north of Iceland, east of the Denmark Strait. Over a small portion of the latter area, near 69°N, 16°W, the percentage frequency of visibility less than 2 mi exceeds 30 percent.

NORTH PACIFIC, SEPTEMBER

WEATHER over the North Pacific continues to be generally pleasant in early September, but, as the month advances, early winter-type storms occur over the northern shipping lanes. Western portions of these routes are also subject to tropical cyclones. A closed Aleutian Low reappears in September, centered over southwest Alaska, with a central pressure of 1007 mb. The 1021-mb subtropical High, near 36°N, 146°W, has weakened considerably and is centered about 300 mi southeast of its August location.

WINDS. The prevailing winds over the middle latitudes of 40° to 60°N are from the western quadrant, shifting to more southerly near the Asian coast, and northerly near the American coast. Over the Bering Sea, they are northwesterly, shifting to northerly over the Bering Strait. The northeast trade winds are predominant south of 30°N, shifting to the north along the American coast, and southwesterly winds predominate over the southern Philippine Sea and South China Sea, where the southwest monsoon is firmly established. There are two areas where the winds appear to be out of phase. One is the northern Gulf of Alaska, with prevailing easterlies; and the other is along the coast of southern China and the East China Sea, with northeasterlies. The average speed is force 3 to 4.

GALES. Winds of 34 kt or higher are encountered between 5 and 10 percent of the time over much of the open Pacific north of about 45° to 50°N over eastern waters, and between about 37° and 45°N over western waters. A typhoon-influenced area of frequencies greater than 5 percent extends from the East China Sea to the Philippine Sea.

EXTRATROPICAL CYCLONES. Well-developed extratropical storms occur more frequently in September than in August. Most of these move northeastward from the Japanese Islands to pass over southwestern Alaska. Others enter the Gulf of Alaska from the waters south of the eastern Aleutians. Storm tracks are displaced southeastward from those of August.

TROPICAL CYCLONES. On the average, four or five tropical storms can be expected in the western North Pacific in September, almost as many as in August. About three of these will achieve typhoon strength. These storms usually originate in the lower latitudes west of about 150°E, and initially move west-northwestward. Some travel across the northern Philippines and the South China Sea, while others recurve in the vicinity of the Philippine Sea to pass over or near the Japanese Islands.

About three tropical storms will whirl off the Mexican coast in any given September. One or sometimes two will usually become a hurricane. These storms either originate over the waters off southern Mexico and move northwestward parallel to the coast (and sometimes inland), or develop near the Revillagigedo Islands and move westward out over the open ocean.

SEA HEIGHTS of 12 ft or more are common 2 to 10 percent of the time north of about 35°N over eastern waters, and north of about 30°N over western waters (excluding the Bering Sea)--as well as over the South and East China Seas, the Gulf of Tehuantepec, and the lower Gulf of California. Two areas of maximum frequency greater than 10 percent are within an elliptically shaped area between 46° and 50°N, and 162° and 179°E, and over the Okhotsk Basin.

VISIBILITY. Fog is less prevalent in September than in August, but it is still frequent north of about 40°N. Frequencies of 10 percent or more of visibility less than 2 mi are common over the waters between 40°N and the Bering Strait, west of 145°W, and east of 150°E. However, the Alaska Peninsula and the Gulf of Alaska, included within the above area, host frequencies of less than 10 percent. A region of frequencies greater than 20 percent surrounds the waters of southern Kamchatka southwestward to the central Kurils, then eastward to Ostrov Beringa.

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